# *Taming To Tackling:*

**Addressing Numeracy Achievement in Low SES schools as a Wicked Problem**


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# ***Statement of Original Authorship and Sources***

This thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma. No parts of this thesis have been submitted towards the award of any other degree or diploma in any other tertiary institution. No other person's work has been used without due acknowledgment in the main text of the thesis. All research procedures reported in the thesis received the approval of the Australian Catholic University Human Research Ethics Committee.

Craig Ashhurst _____

Date _____

# Abstract

This thesis is a qualitative study exploring and comparing the perceptions of stakeholders engaged in trying to improve the numeracy achievement of students in low socioeconomic status (SES) schools. The research was conducted as part of the *Leading Aligned Numeracy Development* (LAND) research project a national literacy and numeracy pilot initiative, funded by the Australian government (DEEWR, 2008).

The outcomes of the LAND research were designed to inform future policy work by the commonwealth, state and territory governments. The purpose of this study was to support these outcomes by trialling a framework and related tools for tackling wicked problems, applying both framework and tools to the specific problem of low numeracy achievement, so that the potential of this type of framework could be tested on a real life problem.

The literature on wicked problems identifies the need for stakeholders to develop a shared understanding for the problem to be successfully tackled. A framework (entitled the Niche Wicked Problem framework) is introduced as a means of supporting tackling wicked problems. The framework was distilled from the literature and informed by the professional experience of the researcher. It includes three interrelated areas: people, systems and context. A shift from 'taming' to 'tackling' in the responses of stakeholders to wicked problems is also required. The framework and the associated use of boundary objects such as causal maps have been used to facilitate this development.

Three types of data collecting methods were conducted within a broad ethnographic methodology.

(i) Survey data from the LAND project were utilised as a foundation for developing (ii) causal maps that were then used as boundary objects in a facilitated

collaborative dialogue process during the LAND workshops. (iii) Observations made during the project were used to shed light on the completed causal maps.

The findings demonstrated both similarities and differences in the patterns of the understandings within and between each group of stakeholders. These patterns aligned with the literature and the dimensions of the framework.

The results of this study provide insights into how different stakeholders view the causes of a wicked problem and how the framework and tools can be used to develop a greater shared understanding and clarity of the problem's dimensions between different paradigms or frames of meaning. First, the Niche framework was found to be an effective vehicle for identifying and analysing the contextual, systemic and people based areas of wicked problems. Second, causal mapping was found to be a practical and effective means of eliciting stakeholder thinking about causes and effects of wicked problems.

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# Abbreviations

| | |
|---|---|
| **ACT** | Australian Capital Territory |
| **ACU** | Australian Catholic University |
| **ANU** | Australian National University |
| **CEO** | Catholic Education Office |
| **DEEWR** | Department of Education, Employment and Workplace Relations |
| **ESL** | English as a second language |
| **LAND** | Leading Aligned Numeracy Development |
| **NAPLAN** | National Assessment Program - Literacy and Numeracy |
| **NT** | Northern Territory |
| **SA** | South Australia |
| **SEP** | Somebody Else's Problem: "is something we can't see, or don't see, or our brain doesn't let us see, because we think that it's somebody else's problem" (Adams, 1990) |
| **SES** | Socioeconomic Status |
| **WA** | Western Australia |

# Acknowledgements

This thesis is almost exactly the same age as my puppy Ruby. Like her, it has grown and changed over the last couple of years with many people having an influence over its growth and direction. So firstly, I would like to thank all my clients and colleagues who prior to this study have asked questions and posed problems that led me to explore the issue of wicked problems in more depth. In particular, Graham Fry for his early critique of the Niche framework and Liz Clarke for her ongoing concept-challenging, discussion and support.

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# 1 Introduction

## 1.1 Addressing Numeracy Achievement in Low SES schools as a Wicked Problem.

The focus problem for this research is the ongoing low level of numeracy achievement of students in low socioeconomic status (SES) school communities.

For the purpose of this study the problem of low student achievement is considered to be an example of an intractable problem, with complex underlying causes. This type of problem involves multiple layers of educational and government systems, related policy, and numerous stakeholders. Each stakeholder group perceives and defines the elements of the problem from its own perspective. The solutions proposed by each group are likely to reflect its specific interests and expertise. This group of factors shifts the problem from a simple "policy disagreement" to a "policy controversy", that is "immune to resolution by appeal to the facts" (Schon, 1999, pp. 3-4). This is also typical of a "wicked problem".

Wicked problems (WPs) are considered difficult to define and near impossible to solve (APSC, 2007). The term 'wicked', in relation to problems, was originally coined by Rittel and Webber (1973) but was given new currency in Australia when the Australian Public Service Commission (APSC) (2007) published the document titled ***'Tackling Wicked Problems: A Public Policy Perspective'***. In this document, 'wicked' was described as referring to "complex policy problems… that go beyond the capacity of any one organisation to understand and respond to" (APSC, 2007, p. 1). Others have noted that wicked problems are characteristic of contemporary policy work in that they have no "clear causes but rather a whole host of loosely connected and interrelated factors … where each policy issue depends on the complex interplay of a wide range of factors and variables" (Ney, 2009, p. 5).

A core difficulty with a wicked problem is that most people try to 'solve it' as a simple or 'tame' problem. (Conklin, 2005, pp. 18-23) A tame problem is

straightforward and lends itself to traditional, linear approaches and solutions usually related to one technical disciplinary paradigm. An example from Schon (1999, p. 3) of a tame problem would be identifying the number of youths involved in drug rehabilitation programs. With clear definitions of youth, time periods, programs, enrolment and location, we can collect the relevant facts and "contending parties should be able to reach agreement on the question." Education policymakers can also tend to treat wicked problems in a tame manner. One example might be attempting to solve the problem of assessing a school's effectiveness by identifying school performance based on only one type of indicator.

The extent of wickedness of a problem, known as wickedity (Bore & Wright, 2009, p. 254), not only depends on the tendency of certain stakeholders to apply different criteria but also the particular disciplinary knowledge underpinning the criteria they employ. A recent news item provides an example of how different disciplines tackle problems differently. The deaths of Australian electricians in 2010 were an unexpected and negative result of the federal government's insulation stimulus package. The response from one stakeholder group, the peak body Master Electricians Australia, was to recommend the fitting of safety switches in all Australian households (Richards, 2010). In comparison, The Australian newspaper quoted an 'expert' as saying, "The only way to avoid deaths was to mandate inspections by electricians before and after insulation was installed" (Berkovic, 2010). Thus, two different expert stakeholders offered two vastly different solutions to the same problem, one a technical electrical installment, and the other a solution focused on governance processes and the specific relevant personnel.

The stance taken in this study is that wicked problems need to be treated differently from tame problems for them to be tackled successfully. They require a framework and related collaborative tools specifically designed to tackle the characteristics of the wickedness of the problem.

## 1.2 Research Purpose

The purpose of this research is to trial a framework and related tools for tackling wicked problems with both the framework and tools being applied to the specific problem of low levels of numeracy achievement of students in low socioeconomic school communities. The Niche Wicked Problem framework has been developed from the policy research literature as well as my experiences as a consultant. The related tools have been selected to enact multiple elements of the framework and provide the greatest leverage and synergy from the participants' time and collaboration.

In this research the framework has been trialled to examine the extent to which:

1) it is both comprehensive and coherent in capturing the range of stakeholder thinking and actions on wicked problems

2) it can be used to explain research findings about wicked problems

3) it provides support in diagnosing and tackling wicked problems (Narayanan & Armstrong, 2005, p. 3)

The value of such a framework was seen in terms of the manner and extent to which it supported the enhancement of a shared understanding and construction of meaning between individuals and groups, and the analysis of critical relationships in public policy systems (Narayanan & Armstrong, 2005, p. 2). The complex nature of wicked problems means that stakeholders need to gain a picture of 'the whole' in order for any positive action to take place. The ambiguity of wicked problems requires that stakeholders develop a shared understanding of the various meanings of key terms and concepts.

Therefore, any processes for tackling wicked problems must involve stakeholders clarifying and sharing their understandings (V. Brown, Harris, & Russell, 2010, pp.

75-79). This may result in stakeholders changing their views and opinions about the problem. Moreover it may involve a re-conceptualisation and therefore provide a different view of how or in fact whether, the problem can be solved. To support this sort of collaborative interaction the literature on wicked problems identifies a number of tools that can be used. These include different types of facilitated dialogue and various forms of conceptual mapping.

For this research a specific type of causal mapping (Craig, 2000), combined with facilitated dialogue (Conklin, 2005), in a collaborative workshop setting, were chosen as the tools that were best designed to enable participants to explore the problem and gain a more strategic understanding of its many elements. The maps also provided a process for investigating the changing stakeholder perceptions of the wicked problem.

Another reason for choosing these tools was the potential for the maps to function as 'boundary objects' that provided participants with a means of reflecting on their own thinking as well as mediating between disparate views (Akkerman & Bakker, 2011). Boundary objects refer to 'artefacts that function as bridges between domains' (S.L. Star, 1989).

Both the framework and tools aligned with the context set for the research by the LAND project, as discussed in the next section.

## 1.3 Research Context

The study is part of the *Leading Aligned Numeracy Development* (LAND) research project funded by the Australian Government under its Literacy and Numeracy Pilot in Low SES Schools Initiative (DEEWR, 2008). The research was undertaken by staff from the Australian Catholic University (ACU). This project formed part of the national effort led by the Australian government to improve outcomes for children

in disadvantaged areas. The outcomes of the research were envisaged to inform future policy work by the commonwealth, state and territory governments, to address the problem of low student achievement.

The 'Leading Aligned Numeracy Development' (LAND) research project investigated the characteristics of numeracy teaching and learning, supporting elements at school and central office level, educational leadership capabilities, and system design principles **that together can improve the numeracy achievement of students in low socioeconomic school communities**. A summary of the project design is presented in Figure #1.1.

The LAND project was founded on the premise that attention to both numeracy and educational leadership is needed to bring about sustainable development in student learning achievement in numeracy. The project has two complementary strands:

1. *The identification, development and support of effective teaching and student learning achievement in **numeracy**; and*
2. *The exercise and development of **educational leadership** in and between classrooms, schools, and central offices to develop and align vision, purpose, priorities, policies, programs, processes, organisational arrangements and community relationships in order to develop, disseminate and sustain effective practices in numeracy teaching and learning.*

There were four pilot sites. Each pilot site consisted of a cluster of schools together with a central office i.e. a Catholic Education Office (CEO) as follows:

1. *Northern Territory – 5 remote Indigenous Catholic Community Schools*
2. *South Australia (Adelaide) - 4 metropolitan Catholic primary schools*
3. *Western Australia (Perth) - 4 metropolitan Catholic primary schools*
4. *Western Australian (Kimberley) - 4 remote Catholic schools*

**Figure 1.1 Key Features of the *Leading Aligned Numeracy Development' (LAND) project* (Gaffney & Faragher, 2010, p. 13)**

The research component of the LAND project relevant to this study relates to the perceptions of various stakeholder groups (school-based teachers and principals, central office personnel and government officers) regarding the nature of the 'wicked problem' of low levels of numeracy achievement of students attending schools in low SES communities.

These LAND project participants were invited to consider the causes of numeracy improvement and the relationship between the various causes. This focus on the perception of underlying causes of this particular wicked problem enabled the trialing of a framework and related tools to tackle wicked problems.

## 1.4 Research Questions

There are three interwoven strands of questions in this research. The first addresses the patterns of participant understanding of the causes of the specified wicked problem that emerge from the collaborative activities undertaken through the LAND project. The second thread is focused on the causal mapping process itself. The third relates to the utility and value of the Niche Wicked Problem framework. The specific questions in each of these threads are outlined below.

### 1.4.1 What are the patterns of causes shown by each stakeholder group, as they relate to improving numeracy?

Questions in this first thread are focused on a key characteristic of wicked problems: the different perspectives stakeholders hold on the same problem. One reason for this is the problem's multiple possible causes and their interdependencies (APSC, 2007, p. 3). Therefore, in order to gain insight into the wicked problem in this study it is important to identify and make explicit how the various stakeholders make

sense of the causes underlying the problem (Weick, 1995, 2000). In the research activities questions were asked relating to the following concepts:

1. **Causal factors:** What are the understandings of the various stakeholder groups about what is required to improve numeracy in low SES schools?

2. **Causal factor groupings:** How do these understandings relate to the LAND Framework concepts of vision, teaching, community, organisation and outcomes? (Gaffney & Faragher, 2010, p. 13)

3. **Causal linkages:** What linkages do individuals and groups make between different factors and in what directions?

4. **Comparisons:** What are the similarities and differences in understandings within and between each group of stakeholders?

5. **Alignment:** What does alignment mean in this context? What are the points of alignment and or misalignment between these perceptions?

6. **Project impact:** What (if any) changes occur in these perceptions over the life of the project?

### 1.4.2 Causal mapping process

The second thread of research questions in this study focuses on the collaborative workshop process, using causal maps, and asks the core question, "Does this process improve participants' understanding of the 'wickedity' (Bore & Wright, 2009, p. 254) of the problem through the use of boundary objects?" That is, do participants grow in their shared understanding of the characteristics of wicked problems as identified in the literature and expressed in the Niche wicked problem framework. The

questions for this thread are based on four dialogical learning mechanisms (Akkerman & Bakker, 2011, p. 151):

1. **Identification** (questioning identity and boundaries of different knowledge cultures): Is there evidence of an increase in awareness of their own and other frames of meaning?

2. **Coordination** (processes for dialogue and mediation): Is there evidence of

    a. the process facilitating conversation and grounding? (Kraut, Gergle, & Fussell, 2002, p. 33)

    b. tacit understandings being made explicit? (Eden & Ackermann, 1992)

3. **Reflection** (coming to realise and explicate differences): Is there evidence of increases in participant understanding (as shown in their maps) of

    a. consideration of alternative ideas and associations, also known as 'cognitive diversity'? (Tegarden, Tegarden, & Sheetz, 2007)

    b. increased complexity? (The number of nodes, where the assumption is that more nodes equal greater complexity.) (Vo, Poole, & Courtney, 2005, p. 145)

4. **Transformation** (changes in thinking that lead to changes in practice): Is there evidence of

    a. a recognition of a shared problem space between participants?

    b. the process encouraging an analysis of critical relationships in a system?

    c. the development of 'hybrid' concepts or ideas.

### 1.4.3 Utility and value of the framework

The third thread of research questions is designed to investigate the explanatory and analytical value of the Niche Wicked Problem framework; in other words, in what ways does the framework:

#### *(i) Provide explanatory value*

Does use of the framework

- provide a straightforward, comprehensive and coherent way of making sense of the range of stakeholder thinking about wicked problems?
- add explanatory value to the findings already identified?
- clarify issues raised in the literature?

#### *(ii) Make sense of symptoms*

- Does use of the framework help to explain the symptomatic responses of stakeholders to the problem?

#### *(iii) Identify taming and tackling behaviours*

- Do participants attempt to tame the problem along one or more of the dimensions of the framework and if so how and why?

#### *(iv) Informing policy development*

- Can use of the framework inform policy development, implementation and evaluation? If so, how?

## 1.5 Research Significance

This research builds on the growing body of knowledge on the nature of wicked problems and what is required to tackle them successfully. Its significance lies in exploring stakeholder perceptions of a specific wicked problem, thus providing insights into how stakeholders contextualise the characteristics of wicked problems. This is important both theoretically and practically.

### 1.5.1 Theoretical Significance:

Although there has been some research on education policy development as a wicked problem, there has been little exploration of the value of a framework and related tools for tackling this type of problem. Therefore this research will be significant for informing educational policy development by identifying relevant dimensions of wicked problems and their conceptual and theoretical underpinnings. In particular the value of such a framework and tools will be seen in terms of the manner and extent to which they support the enhancement of a shared understanding and construction of meaning between individuals and groups, and the analysis of critical relationships in public policy systems (Narayanan & Armstrong, 2005, p. 2).

The use of causal mapping as both a research method (Hughes, Al Shebab, & Eastwood, 2004; Langfield-Smith, 1992; Marcoczy & Golderberg, 1995; Narayanan & Armstrong, 2005) and a boundary object (Akkerman & Bakker, 2011) also has significance for expanding the potential of qualitative research approaches that "help us recognise and treat the fluidities, leakages and entanglements that make up the hinterland of research"(Law, 2004, p. 41).

### 1.5.2 Practical Significance:

The growing recognition of the wickedity of many of the problems of modern society highlights the need for accessible, understandable and highly functional tools for tackling them (APSC, 2007; Bore & Wright, 2009). This study is practically significant as it is designed to provide both a framework and related tools that can be used by different stakeholders 'connected' to the same problem. The framework, through the use of six dimensions, summarises the literature on wicked problems, and is designed to provide a basis for discussion and action. The collaborative dialogue activities using causal mapping are designed to be trialled and refined to support ready replication.

A key element in tackling wicked problems is the development of greater clarity and shared meaning among different stakeholders on the nature of the problem (in this case low numeracy achievement of students in low socioeconomic school communities). In this research the use of causal mapping as a tool for collaborative dialogue and professional reflection (Conklin, 2005; Schon, 1983, 1990, 1999) was proposed as the means for developing greater clarity of shared meaning.

## 1.6 Assumptions and Limitations

Several assumptions were made in this study in order to focus the processes of data collection and analysis. These include the view that each group of participants took part in the research willingly and honestly and that their contributions (e.g. causal maps and commentary) are true indications of how they view the factors/causes of numeracy development.

There are a number of limitations in this research. First, access to research participants was limited in time and the nature of potential interactions. Second, these participants only represent educational and government stakeholder groups,

not communities or families. Hence the range of perspectives was limited. Another limiting factor was that this study was part of the LAND project and therefore had to align with the research focus and period of that study. Consequently, the data collection activities were selected to investigate multiple elements of the wicked problem framework and provide opportunities for as much leverage and synergy as possible from the participants' time and collaboration. The analysis of this data was also deliberately restricted to the perspectives of the various stakeholders on the causes of this wicked problem, rather than include potentially related analyses of research on factors influencing student numeracy achievement.

The rationale for these assumptions and limitations will be discussed further in the following chapters.

## 1.7 Chapter Summary

This introductory chapter has presented the focus of this research as the low level of numeracy achievement of students in low socioeconomic school communities. The proposition of this research is that problems of this nature, labelled 'wicked', need to be tackled in a collaborative manner, involving a range of stakeholders. Further, it is proposed that tackling wicked problems will be more successful if a suitable framework and related tools are developed specifically for the process.

The purpose of this research is to trial such a framework and related tools. The research was part of the LAND project and operated within the context of this project's objectives and processes. Facilitated, collaborative, causal mapping activities were conducted with participants from three levels of education systems: schools, central offices and federal government employees. These activities were designed to elicit the perceptions of these stakeholders on the underlying causes of numeracy improvement and the relationships between these various causes. Three

strands of research questions were presented investigating (i) the patterns of cause and effect, (ii) the causal mapping process and (iii) the utility and value of the framework. The significance, assumptions and limitations of this research have also been outlined.

### 1.7.1 Thesis Overview

This study comprises 8 chapters. Chapter I introduces the research. Chapter 2 summarises the relevant literature, with Chapter 3 providing relevant reflections on my professional experience of dealing with wicked problems. Chapter 4 presents the Niche Wicked Problem framework. The research design, methodology and methods are presented in Chapter 5. Chapter 6 details the findings, and Chapter 7 applies the Niche framework to the results. Chapter 8 presents a set of conclusions and recommendations for practice and further research in this field of study.

# 2 Literature Review

## 2.1 Introduction

Ongoing low levels of numeracy achievement of students in low socioeconomic status (SES) school communities is a complex and multilayered problem that can be seen as a type of wicked problem (Bore & Wright, 2009). So what makes a problem 'wicked'? Recently, all sorts of problems and issues are being called ''wicked", not in the sense of evil, but complex, difficult to define and understand, as well as resistant to solving. (APSC, 2007, p. 3; Rittel & Webber, 1973) This is in comparison to 'tame' problems, which are simple, straightforward and lend themselves to traditional, linear approaches and solutions, usually related to one technical disciplinary paradigm. (Schon, 1999, p. 23) While there is a minority view that denies the existence of wicked problems and/or the need to treat highly complex problems any differently from less complex ones (Batie, 2008; Hunter, 2008; Johns, 2008), the stance taken in this study is that wicked problems exist and need to be treated differently from tame problems for them to be tackled successfully. They require a framework specifically designed to deal with the characteristics of 'wickedity', the term used by Bore and Wright (2009, p. 254) to describe degrees of wickedness while avoiding moral overtones.

This chapter is presented in two parts. The first will comprise an overview of the relevant literature on policy and wicked problems. This includes a brief definitional review of policy literature and then presentation of the argument that wicked problems exist, and an overview of the growing literature on wicked problems. This overview highlights the concepts and ideas associated with contemporary public policy research and development, and the issues and strategies related to tackling wicked problems in policy. Secondly, an overview of the research underpinning the LAND project is reviewed. This includes both the effects of poverty on schooling outcomes and literature related to developing numeracy in low socioeconomic status schools.

## 2.2 Policy Defined

Tackling wicked problems has significant implications for public policy, but 'policy' is a highly ambiguous term. Colebatch (2009, p. 2) provides examples of the diversity of usage, including:

- Justification for action
- Broad orientation
- Indication of normal practice
- A specific commitment
- Statement of values

There are also multiple definitions of 'public policy' (McConnell, 2010, pp. 4-6) with each focusing on different aspects of "whatever governments choose to do or not to do" (Dye, 2005, p. 1). Such ambiguity can make it difficult to discuss the impact of wicked problems on policy. Clearly, how this impact is assessed will be dependent on how one defines both the term 'wicked problem' and 'policy'.

### 2.2.1 Two policy heuristics

Therefore, two defining heuristics will be used to clarify the parameters of the use of the term 'public policy' throughout this study. McConnell's (2010, p. 46) three dimensions of policy success, as shown in Table #2.1, provides a way of dividing up the themes of policy, and then presents measures against which the success of a policy can be assessed from the perspective of each dimension. His dimensions are:

- **Process:** refers to policy-making and implementation (McConnell, 2010, p. 40).

- **Programmes:** refers to the outcomes from specific government action (McConnell, 2010, p. 46)
- **Politics:** pertains to government, its capacity to govern and the values it seeks to promote (McConnell, 2010, p. 50)

| ***Table 2.1 Three Main Dimensions of Policy Success*** | |
|---|---|
| Process | Preserving policy goals and instruments<br>Conferring legitimacy<br>Building a sustainable coalition<br>Symbolizing innovation and influence |
| Programmes | Meeting objectives<br>Producing desired outcomes<br>Creating benefit for target group<br>Meeting policy domain criteria |
| Politics | Enhancing electoral prospects/reputation of governments and leaders<br>Controlling the policy agenda and easing the business of governing<br>Sustaining the broad values and direction of government |

The second heuristic is provided by Colebatch's (2009, p. 35) diagram of the different accounts of policy that stress different aspects of the processes at work between stakeholders, see Figure #2.1. His three interrelated aspects of policy practice are

- **The vertical:** focused on authoritative leadership making choices that are then implemented by subordinates.
- **The horizontal:** the interactions between stakeholders.
- **Scene setting:** the different shared 'frames' of understanding that may exist around the issues involved in the policy.

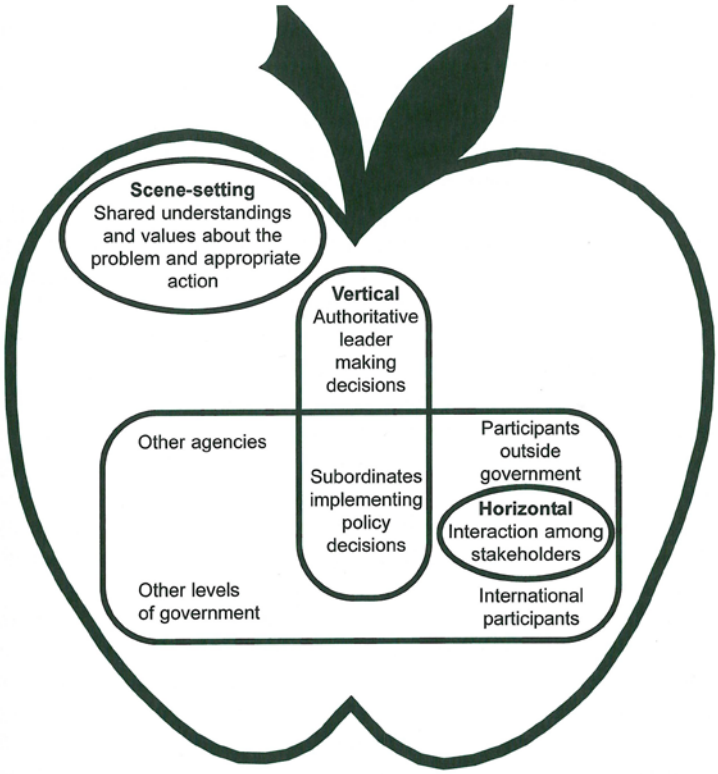


**Figure 2.1. Aspects of policy practice (Colebatch, 2009, p. 35)**

Together, these two heuristics provide the range of meaning for the use of public policy throughout this study. They provide a definitional stance for whenever the term 'public policy' is used throughout this thesis and will be discussed in detail in the final chapter that considers the conclusions, implications and recommendations from the findings of this research. For our purposes then, public policy includes three dimensions; process, programmes and politics and each of these policy dimensions needs to be considered when tackling the wicked problem of the ongoing low level of numeracy achievement of students in low socioeconomic status (SES) school communities. Traditionally, the process of policy development keeps the various groups represented in Colebatch's diagram (See Figure #2.1) separate or interacting in a limited way across clear boundaries. In contrast, tackling wicked problems requires collaborative interactions between stakeholders across all boundaries. With 'policy' clarified, I will now turn to defining the other key term in this study, 'wicked problem'.

## 2.3 Wicked Problems: A Type Of Complex Problem

VanPatter (2007a, p. 3) provides an overview of publications dating back to 1910 showing a belief in the rising complexity of problems and the consequent need to recognise a new category of problem and approach to tackling them. This overview of twenty seminal publications includes emerging concepts for tackling complex problems, such as creative problem solving, lateral thinking, and the use of metaphors and synectics. Head (2008b, p. 101) notes these trends in stating that "a variety of critiques had emerged concerning the perceived dominance of rational-technical or 'engineering' approaches to complex issues of social policy and urban planning."

By the 1970s there was a growing consensus around the need to describe the emerging types of problem, and contrast them with what had existed previously. This has resulted in the generation of a number of new terms:

- Policy controversy vs. policy disagreement (Schon, 1999, pp. 3-4)
- Complex vs. simple (M Basadur, et al., 2007a, p. 21)
- Generation two vs. generation one (Rittel & Webber, 1973)
- Wicked vs. tame (Rittel & Webber, 1973)
- Messes (Ackoff, 1974)
- Social messes (Horn & Weber, 2007)
- Messy policy problems (Ney, 2009, pp. 4-11)
- Ill-structured vs. ill-structured problems (Mitroff & Mason, 1980) (Min Basadur, Pringle, Speranzini, & Bacot, 2000)
- Type III Situation or adaptive problem (Heifetz, 1994) & (Beinecke, 2009, p. 2)
- Tangled problems (Dawes, Cresswell, & Pardo, 2009)

This list shows that there are a number of alternative labels describing this type of problem, some focusing on problems as a general social issue, and some in terms of policy. For this thesis I have chosen to use the term 'wicked' due to both its increased recent currency and its potential for comprising multiple dimensions of meaning. Originally coined by Rittel and Webber (1973), 'wicked' was the term used to describe a category of problem that was different from simple, disciplinary or 'tame' problems. The label has recently come to be also used in reference to policy issues. (APSC, 2007)

### 2.3.1 Wicked and Tame problems compared

A comparison of the elements involved in tame and wicked problems are presented in Table #2.2.

***Table 2.2 Tame And Wicked Problems Compared***

| | Situation | Tame Problem | Wicked Problem |
|---|---|---|---|
| 1 | Problem Framing | Can be exhaustively defined, bounded & solved within bounds | Indefinable & subjective problem framing |
| 2 | Problem Solving Finality | Have a clear solution; an endpoint, closure | With subjective problem framing resolutions are indeterminate (i.e. it is impossible to objectively determine if and when it is resolved) |
| 3 | Resolution Measures | Testable solutions enabling error detection & correction. Thus, determinability of correct or incorrect. | No unambiguous criteria and multiple subjective perspectives. Thus, no single correct answer. Resolutions are not correct or incorrect but only degrees of good or bad. (Satisficing decision approach) |
| 4 | Resolution Testability | Have an exhaustive, enumerable list of permissible solution options. | There is no definitive criteria system or rule can definitively determine right or wrong. (No pre-test) |
| 5 | Solution Attempt Consequences | The problem can be isolated and the solution is either right or wrong regardless of how, when, why or where. | Each resolution attempt counts, as there is the potential for significant consequences (No trial and error; single chance) (Emergent & interdeterminate consequences) |
| 6 | Solution Bounds | Tame problems have well-defined and bounded solution options (what is) | Multiple perspectives leading to multiple explanations leading to multiple solutions (unbounded solutions & subjectively judged) |
| 7 | Problem/Resolution Uniqueness | A reusable formula can be found | Essentially unique: similarities but uncertain of significant distinguishing characteristics. (Tailor-made resolutions) |
| 8 | Causality Perception | Are well formed, bounded and their causes are clear. | Are ill-structured, unbounded and causality is ambiguous & subjective; thus, where to attack the problem is unclear. |
| 9 | Problem/Solution Relationship | Problem can be forged separately from any notion of the solution | Understanding the problem is synonymous with solving it. Causes can be perceived and explained in numerous ways, which will influence resolution |

| | | | |
|---|---|---|---|
| | | | options. |
| 10 | Responsibility | Tame problems can be solved without prejudice | Problem solvers have only one chance to produce a good outcome.<br>Policy makers are liable for their policies and actions.<br>Praise is not granted as it is not clear if and when the problem is solved. |
| | | | Source: (Ohl, 2008, p. 37) |

The elements shown in Table #2.2 relate to the work done by Rittel and Webber in the 1970s. Recent authors have focused on different elements to describe the characteristics of wicked problems. An overview of the recent usage of the term in the literature follows in the next section.

### 2.3.2 Increasing use of 'Wicked' in the literature

While the term 'wicked' in regard to problems has been employed since the 1970s, the last few years has seen a massive increase in its currency in both research literature and in the mass media. The growth in the use of the term in popular media from 2002 till June 2011, as identified by the online database Factiva, is shown in Figure #2.2. Initially with less than ten articles a year till 2005, the term rapidly increases to approximately one hundred in 2010. By June 2011 that number has already been overtaken.

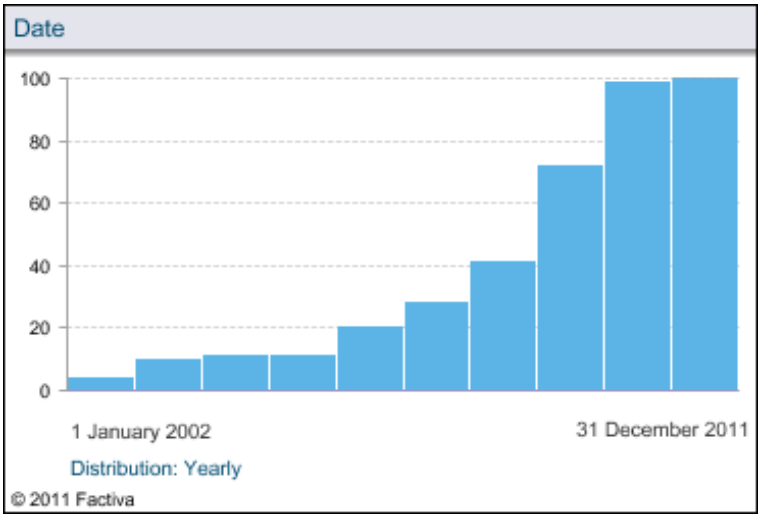


Figure 2.2. Factiva Results for search 'wicked problems' 20/6/2011

This recent interest has been reflected in Australian academia by four significant publications from widely divergent sources and perspectives.

1. Australian Public Service Commission's (2007) Tackling Wicked Problems: A Public Policy Perspective. Commissioned by the head of the Australian Public Service, this document is one of three key strategic papers presented for the future direction of the public service. The focus is intentionally on policy and the potential impact on the public service of treating policy development as a wicked problem.

2. Brown, Harris & Russel, (2010) Tackling Wicked Problems: Through the Transdisciplinary Imagination. This book arises from the Human Ecology Discussion Forum at the Fenner School at the Australian National University (ANU). The focus is on collaborative learning and transdisciplinary approaches to tackling wicked problems. The scope of this book is broader than the APSC paper, with an emphasis on sustainability and the physical and social sciences.

3. Cutler & Burry, (2010) Designing Solutions to Wicked Problems: A Manifesto for Transdisciplinary Research and Design. This online book presents the proceedings from a design conference on wicked problems. The focus is on design and transdisciplinarity, with clear overlaps with the ANU work by Brown et al (2010). However, the design roots of this book raise the complexity and ambiguity issues more than questions of sustainability.

4. Schultz (2011) Wicked Problems, Exquisite Dilemmas. This is a special edition of a quarterly journal, The Griffith Review, in which the various articles demonstrate a range of topics and angles under the heading of 'wicked problems'.

This currency has provided a common term for labelling this type of problem, which is becoming a de facto standard. Head (2008b, p. 103) has pointed out that "the attraction of the 'wicked problem' concept is that it seems to provide additional insights concerning why many policies and programs generate controversy, fail to achieve their stated goals, cause unforeseen effects, or are impossibly difficult to coordinate and monitor." The term 'wicked' has come to be associated with those challenging the rational-technical approach to problem solving (M Basadur, et al.,

2007a; M Basadur, Conklin, & VanPatter, 2007b, 2007c; Min Basadur, et al., 2000). One concern for those challenging the rational-technical approach was that attempting to solve this new type of complex problem as if it were a traditional type of problem would result in an exacerbation of the issues rather than a solution (Head, 2008b, pp. 101-102). Therefore, these authors consider it important to differentiate clearly between tame problems that range in complexity and wicked problems. This difference is shown in Figures #2.3 and #2.4, which represent these two options for conceptualising increasing complexity in the nature of policy problems.

### 2.3.3 Option #1: Gradual increase in complexity

There appears to be general consensus that issues facing our modern society have become more difficult to solve, but some authors consider this to be merely a ramping up of the complexity of the issues (Schon, 1999, pp. 3-20). In this view, traditional methods for resolving the problem can be used, even though they may take more time. This approach has been sometimes been called normal science (Batie, 2008). Therefore our first option in Figure #2.3 is a continuous line because although the problems are increasingly complex they can still be solved using a technical-rational or normal science approach.

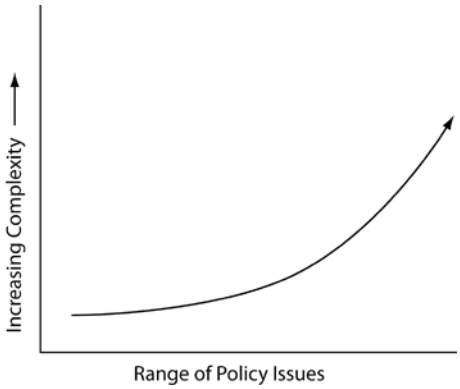


**Figure 2.3 Same type of problem – increasing complexity**

### 2.3.4 Option #2: Disjunction between technical rational (tame) and wicked problems.

In contrast, those arguing that a new kind of problem has emerged, (i.e. wicked problems), believe that these are categorically different from tame ones, even if they share increased complexity as a characteristic. This question of increasing complexity is addressed in Head's (2008b) paper, Wicked Problems in Public Policy. He argues that "complexity is clearly a constituent feature of wickedness, but complexity itself is not enough to trigger a wicked problem since there are many aspects of complexity that are amenable to scientific analysis and technical/engineering controls" (Head, 2008b, p. 103).]

In his diagram depicting three dimensions of wickedity, as presented in Figure #2.4, Head (2008b, p. 104) shows that these problems are characterised by high levels in each dimension, rather than complexity alone.

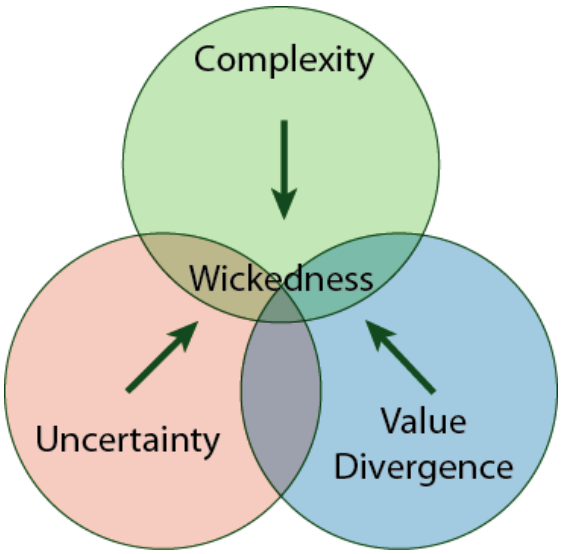


**Figure 2.4. Different type of problem**

Schon's (1999) distinction between policy disagreement and policy controversy also identifies a difference between tame and wicked types of problem. He uses 'policy disagreement' (tame problems), to refer to disputes that can be resolved by

analysing the 'facts' of the situation. The evidence can be examined objectively and agreement can then be reached. In contrast, 'policy controversies' (wicked problems) are immune to resolution by appeal to the facts. This is because a disagreement about facts often masks an underlying dispute between stakeholder patterns of thinking (Schon, 1999, p. 4).

## 2.4 'Viewing' Wicked Problems: Differences In 'Frames'

These differences in patterns of thinking, as they relate to policy, have been variously described as a difference in 'paradigm', as introduced by Kuhn (1996); 'worldview' based on the German word *weltanschauung* (world perception), as defined by Naugle (2002, p. 64); 'frame' as used by Schon & Rein (1999); thought styles and collectives (Pohl, 2011); and knowledge cultures (V. Brown, 2008). Whilst not meaning precisely the same thing, each of these terms describes a way of looking at and interacting with the world. In this thesis the term 'frame' will be used in this general sense of "theoretical framework… or ordering of reality which gives meaning to facts" (Bullock, 1988, p. 626) or a set of underlying structures of beliefs and perception (Schon, 1999, p. 23). The use of frames in this way allows the focus of the study to be on the general perceptions and sense-making of participants, thus avoiding the more specialised debates that surround other terms such as discourse (Scollo, 2011; Verschueren, 2011).

With wicked problems, stakeholders typically do not share a common frame. Further, as Schon has argued, one's frame determines what one accepts as a fact and which arguments are taken to be relevant and compelling. Also the different value sets inherent in different frames leads to a different set of priorities on the same set of facts. Therefore, such disputes are resistant to resolution by appeal to facts alone. (Schon, 1999, pp. 4-5).

Moreover, the frames that shape policy positions and underlie wicked problems are usually tacit, which means that they are exempt from conscious attention and reasoning (Schon, 1999, p. 34). Therefore, each stakeholder group in a wicked problem perceives and defines the elements of the problem from the perspective of their own frame without necessarily being aware of the alternative view of reality being used by other stakeholders. These differences in frames make exact defining of the boundaries of a wicked problem difficult. In the literature this issue of definition has been primarily resolved by providing a list of characteristics of wicked problems.

## 2.5 Characteristics Of Wicked Problems: A Problem

As discussed, defining 'wicked' problems is problematic, with little agreement in the literature on what constitutes a complete description. Definitions tend to be presented as a list of characteristics, but there is little agreement on what should be included in the 'best set' of characteristics. Each listing emphasises an aspect of complex problems and how to tackle them. For example, Ackoff (1974, p. 21) wrote about complex problems as messes: "Every problem interacts with other problems and is therefore part of a set of interrelated problems, a system of problems…. I choose to call such a system a mess." Extending Ackoff, Horn (2007, p. 6) speaks of "a Social Mess [as] a set of interrelated problems and other messes. Complexity—systems of systems—is among the factors that makes Social Messes so resistant to analysis and, more importantly, to resolution." In contrast to this **systemic** approach, Schon (1999) and Ney (2009) emphasise the competing **frames** or paradigms of the stakeholders involved in the problems, while Rittel's (1973) list of characteristics focuses on the **ambiguity** and uncertainty of the problem.

A related issue has been the degree of diversity in the characteristics listed. This has made it difficult to precisely describe these problems, or to use a list in a functional way. Unconnected descriptors make it difficult to grasp what is involved in tackling wicked problems. This can be demonstrated by comparing three lists of characteristics. Rittel and Webber (1973) identified ten primary characteristics of wicked problems, Horn (2007), fourteen characteristics of 'social messes', and the Australian Public Service Commission (2007), eight characteristics of 'wicked policy problems'.

***Table 2.3 Comparing Characteristics of Wicked Problems***

| No. | Rittel & Webber (1973) | APSC (2007) | Horn & Weber (2007) |
|---|---|---|---|
| 1 | There is no definitive formulation of a wicked problem, i.e. even the definition and scope of the term is contested; | Difficult to clearly define | No unique "correct" view of the problem; |
| 2 | Wicked problems have no 'stopping rule', i.e. no definitive solution. | Many interdependencies and multi-causal aspects | Different views of the problem and contradictory solutions; |
| 3 | Solutions to wicked problems are not true-or-false, but good-or-bad in the eyes of stakeholders. | Proposed measures may have unforeseen effects | Most problems are connected to other problems; |
| 4 | There is no immediate and no ultimate test of a solution to a wicked problem. | Problems may be unstable and continue evolving | Data are often uncertain or missing; |
| 5 | Every (attempted) solution to a wicked problem is a 'one-shot operation'; the results cannot be readily undone, and there is no opportunity to learn by trial-and-error. | No clear and correct solution | Multiple value conflicts; |
| 6 | Wicked problems do not have a clear set of potential solutions, nor is there a well described set of permissible operations to be incorporated into the plan. | Problems are socially complex with many stakeholders | Ideological and cultural constraints; |
| 7 | Every wicked problem is essentially unique. | Responsibility stretches across many organisations | Political constraints; |
| 8 | Every wicked problem can be considered to be a symptom of another problem. | Solutions may require behavioural changes by citizens and stakeholder groups. | Economic constraints; |
| 9 | The existence of a discrepancy representing a wicked problem can be explained in numerous ways. | | Often a-logical or illogical or multi-valued thinking; |

| | | | |
|---|---|---|---|
| 10 | The planner has no 'right to be wrong', i.e. There is no public tolerance of initiatives or experiments that fail. | | Numerous possible intervention points; |
| 11 | | | Consequences difficult to imagine; |
| 12 | | | Considerable uncertainty, ambiguity; |
| 13 | | | Great resistance to change; and, |
| 14 | | | Problem solver(s) out of contact with the problems and potential solutions. |

It is a contention of this research that tackling wicked problems requires a usable synthesis of the disparate characteristics into a more functional framework. Some authors have attempted to do exactly this. For example, Head (2008b, 2008c) sought to create a model of what makes problems 'wicked'. In particular, he developed the idea of multiple dimensions of a problem, the interplay of which moves in a continuum from tame through to increasingly wicked. His first attempt used two dimensions, *diversity* and *complexity*, as shown in Figure #2.5.

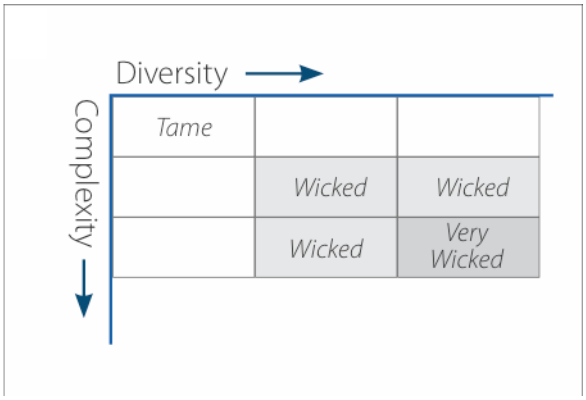


**Figure 2.5 Wickedity dimensions (Head, 2008b)**

**Diversity** refers to the social differences of stakeholders linked to the problem. Head (2008b, p. 102) pointed out that "technical, (tame) approaches are bound to overlook the values, perspectives and lived experience of the stakeholders and citizens who are directly or indirectly assisted or involved in these interventions."

Horn (2007) agrees, presenting social 'messes' as a core element in wicked problems. He argues that different social groups can have very different perspectives on a problem. In many cases their worldviews are competing or incompatible in values and ideology. Stakeholders can differ in age, social status, gender, ethnicity, education, and in many other ways. These differences impact on how stakeholders define the problem, the outcomes they want, what interventions are possible and what consequences will be acceptable. People also differ in knowledge of the problem, with different people apprehending different parts of the problem and consequently proposing different potential solutions.

The second dimension identified by Head (2008b, p. 103) is **complexity**. Complexity is defined as being primarily about systems: the number of elements within each system, the number of systems involved, how the systems interact with each other, and how intricate the whole 'mess' is. By 'intricacy' is meant the number of links between different parts of each system and to other problems, the many possible points for intervention, and the consequences of intervening (2008b, pp. 103-104). The issue of complexity has led some authors to look for insight in research from scientific arenas such as chaos theory and complex adaptive systems (Gharajedaghi, 2005; Sanders, 1998; Stacey, 1992).

The simplicity of Head's original model is attractive but it notably lacked a number of the characteristics identified in the three lists above. For example, Horn & Weber (2007) argue that ambiguity is a key characteristic associated with wicked problems. Subsequently Head incorporated some of these other characteristics into a revision of his model (Head, 2008c), shown in Figure #2.6, presented previously. 'Uncertainty' is introduced as a third dimension, and 'diversity' was changed to 'value divergence'. These changes highlight the fluid nature of the understanding of wicked problems, raising the question as to whether it is in fact possible to group characteristics of such problems in a way that provides an accessible model.

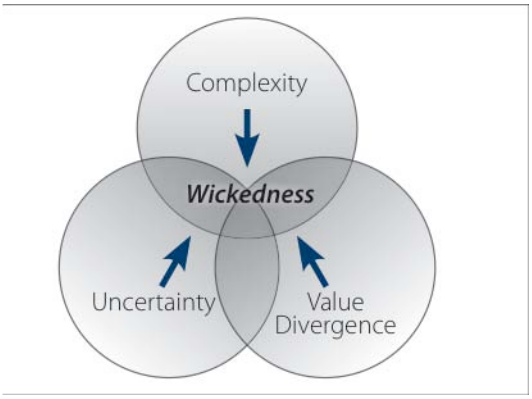


**Figure 2.6 Dimensions of Wickedity (Head, 2008c)**

One purpose of this study is to trial a framework that incorporates the significant characteristics of wicked problems grouped in a way that can be readily visualised and understood. A number of authors have identified that most people can only hold three to nine concepts in mind at anyone time (Card, Mackinlay, & Shneiderman, 1999; Craig, 2000; D. Hyerle, 1996; Spence, 2000; Ware, 2000). This limitation in human short term memory means that an accessible model for wicked problems would ideally have no more than nine dimensions and preferably as a few as possible. The value of a visual model to represent a wicked problem framework will be discussed further in Chapter #4.

## 2.6 Strategies For Dealing With Wicked Problems: Taming Vs. Tackling

A tame problem is straightforward and lends itself to traditional approaches and solutions usually related to one technical disciplinary paradigm. As Conklin (2005, p. 18) explains, "A tame problem is one for which the traditional linear process is sufficient to produce a workable solution in an acceptable timeframe." This is not to say that a tame problem cannot be technically complicated, but that specialist disciplines have developed agreed generic principles and tested linear methods for successfully solving such problems (Bore & Wright, 2009, p. 242).

A wicked problem is a different type of problem that cannot be 'solved' like a tame problem. For example, Raisio (2009, p. 481) contends that one can only hope to 'cope with' or 'survive' wicked problems, while others consider wicked problems can be 'tackled' and therefore lead to an improved situation or circumstance (APSC, 2007; Bore & Wright, 2009; V. Brown, et al., 2010; Conklin, 2005; Frame, 2008).

Key elements in tackling wicked problems have been identified in the literature:

1. Developing a shared understanding between stakeholders (Conklin, 2005)

2. A willingness to consider the problem from a holistic point of view (V. Brown, 2008; V. Brown, et al., 2010; Gray & Gill, 2009; Waddock, 1998)

3. Collaborative and transdisciplinary approaches that enable the tacit frames of stakeholders to become more explicit and comprehensible to other stakeholders. (Aboelela, et al., 2007; Bore & Wright, 2009; Cutler & Burry, 2010; Polk & Knutsson, 2008)

The APSC (2007, p. 11) report reflects a similar understanding, stating that "any package of measures identified as a possible solution usually requires the involvement, commitment and coordination of multiple organisations and stakeholders to be delivered effectively."

The different ways of dealing with tame and wicked problems, drawn from the literature, are compared in Table #2.4 following.

| *Table 2.4 Comparing ways of dealing with tame and wicked problems* | |
|---|---|
| Tame problems | Wicked problems |
| • Linear approaches | • Iteration and interaction |
| • Conventional problem solving methods | • Creative and innovative approaches to problem solving |
| • Solving parts and then aggregating | • Systemic & holistic approaches |
| • Solvable by technical experts alone | • Collaboration of all stakeholders required |
| • True or false solutions | • Good or bad solutions |
| • Solved | • No solution but can be improved |
| • Finite elements & consequences | • Potentially infinite elements & consequences |
| • Clear boundaries | • Ill-structured, unbounded and ambiguous causality |
| • Understanding the problem before solving | • Tackling the problem as understanding increases |
| Sources: (APSC, 2007; Bore & Wright, 2009; V. Brown, et al., 2010; Conklin, 2005; Frame, 2008; Ohl, 2008) | |

A conclusion that can be drawn from Table #2.4 is that a first step in tackling a wicked problem is to recognize its nature, that is identifying it as wicked. This is not a straightforward exercise, as noted by Conklin (2005, p. 19):

> "Issues and problems in the real world occur on a spectrum from tame to wicked, and there is a natural human desire to have problems be tame and to avoid the wicked ones… Most problems have degrees of wickedness"

This human tendency to resist identifying a problem as wicked can lead to attempts to tackle it as though it were tame. This results in the problem not being solved, and even possibly exacerbated. Instead, tackling a wicked problem requires the use of appropriate strategies.

Three groups of strategies that have been identified in the literature (APSC, 2007, pp. 9-11; Hancock, 2010, pp. 55-62) for dealing with wicked problems correspond with Colebatch's three different accounts of policy as shown in table 2.5 below and then described in the following sections.

***Table 2.5 Comparison of wicked problem strategies and policy accounts***

| Wicked problem strategies | Colebatch Policy Accounts |
|---|---|
| Authoritative | Vertical (authoritative) |
| Competitive | Horizontal (Stakeholder interaction) |
| Collaborative | Scene-setting (Shared understandings) |

(Colebatch, 2009, p. 35)

### 2.6.1 Authoritative strategies:

Authoritative strategies are governed by the formal power and decision-making responsibilities of a key stakeholder or stakeholder group. Such approaches 'solve' the problem of multiple perspectives on the problem and possible solutions by reducing the options to a single dominant perspective. This has led to policy 'enactments' that move towards "greater standardization, coordination, and integration" (Fenwick & Edwards, 2011, p. 709).

Wicked problems are thus tamed and the result aligns with the paradigm or frame of the authoritative group. This reduction of the complexity of the problem through reducing the number of perspectives involved in the solution is efficient and effective for producing a clear result, but such a result may "later be considered ill founded" (Hancock, 2010, p. 59). A related problem of authoritative strategies is the potential alienation and marginalisation of stakeholders in less powerful positions. (APSC, 2007, p. 9)

### 2.6.2 Competitive strategies:

Competitive strategies are characterised by market-based approaches with win-lose outcomes as stakeholders compete with one another. Advantages of such approaches are the potential for innovation and choice, but on the whole the result is a taming of the complexity of the wicked problem by reducing the problem definition to just one 'winning' frame. (Hancock, 2010, p. 60)

Disadvantages of this approach include conflict, stalemates and wasted resources. The most significant weakness is that it results in the dominance of the paradigm or frame of only one stakeholder group in a multi-paradigmatic problem. (APSC, 2007, p. 10) As with authoritative strategies, competitive strategies tend to tame rather than tackle the wickedity of the problem.

### 2.6.3 Collaborative strategies:

Collaborative strategies pursue a win-win approach through dispersing power and decision-making between multiple stakeholders (Aboelela, et al., 2007; Austin, 2000; Min Basadur, et al., 2000; Carpenter, 2009; Choi & Pak, 2008; Godemann, 2008; Tamm & Luyet, 2005). The advantage of this approach is that a more comprehensive range of perspectives and options are considered, as multiple frames are included in the process. Further, there is potential to build stakeholder commitment and 'buy in' (Monsey, 2001; Winer & Ray, 1994). Disadvantages include the increased cost and time required for information transactions and decision-making (Hancock, 2010).

Collaborative strategies seek to combine the efforts of stakeholders in some form of functional partnership, through alliances, joint ventures, participatory research and coalitions (Austin, 2000; Carpenter, 2009; Choi & Pak, 2008). Such approaches are advocated by authors who place collaboration within a 'transdisciplinary methodology' (APSC, 2007, p. 10). Brown (2010, p. 4) defines 'transdisciplinary' as

"the collective understanding of an issue; it is created by including the personal, local and the strategic, as well as specialised contributions to knowledge."

Pohl (2011), reviewing the use of the term 'transdisciplinary' in the literature, considers its meaning to be still contested. He explains the differences in how the concept is defined in terms of clusters of features as shown in table #2.6.

| ***Table 2.6 Transdisciplinarity*** | Sub types | | |
|---|---|---|---|
| Features of transdisciplinarity | A | B | C |
| Relating to socially relevant issues | ■ | ■ | ■ |
| Transcending and integrating disciplinary paradigms | ■ | ■ | ■ |
| Participatory research | | ■ | |
| Searching for a unity of knowledge | | | ■ |
| Source: (Pohl, 2011, p. 620) | | | |

He identifies three sub-types: A, B and C. Each sub-type includes social relevance and transcending disciplinary paradigms. Authors in sub-type A only utilize these two features. Sub-type B authors include non-technical stakeholders in the research, while sub-type C authors try to develop an overall unity of knowledge. While Pohl's sub types are helpful for clarifying the range of usage of 'transdisciplinary', all four features are relevant for this study and should be assumed in the use of the term throughout this thesis.

Therefore, of the three groups of strategies for tackling wicked problems, authoritative and competitive approaches tend to tame the problem, whereas the collaborative strategies provide an approach that enables multiple frames of understanding to be brought to bear on the problem. Consequently, this study adopts a collaborative strategy, within a transdisciplinary methodology, for tackling the wicked problem under exploration. Selecting this approach focuses the study

and leads to the next section, which explores 'tools' which facilitate a transdisciplinary and collaborative strategy.

## 2.7 Collaborative Concepts And Tools For Tackling Wicked Problems

Authors commonly define wicked problems as unsolvable (APSC, 2007; Rittel & Webber, 1973). However, the literature also notes that they can be 'tackled' to some degree, but that this requires new ways of thinking and new tools to support them (Schon, 1999). For example Ackoff (1991) reminds us: "We [have been] attempting to deal with problems generated by a new age with techniques and tools that we inherit from an old one."

Tools that are effective for tackling wicked problems are collaborative in nature and help to make explicit the tacit, multiple frames associated with a diverse group of stakeholders (Abernethy, Horne, Lillis, Malina, & Selto, 2005, p. 137; Narayanan & Armstrong, 2005). Tools also need to support the development of a shared understanding between stakeholders of the complexity of the problem (V. Brown, et al., 2010). The literature highlights the following features of these types of tools:

### 2.7.1 Dialogue

Dialogue is a particular form of conversation between stakeholders, defined by Isaacs (Isaacs, 1999) as "a shared inquiry, a way of thinking and reflecting together… A living experience of inquiry within and between people", in which two or more people "are making something in-common i.e., creating something new together" (Bohm, 1996). This form of conversation is seen as different from debate and discussion and seen by authors as vital for tackling wicked problems. (Bohm, 1996;

Conklin, 2005; Ellinor & Gerard, 1998; Flick, 1998; Isaacs, 1999; Staples & Webster, 2008; Yankelovich, 1999) Table #2.7 demonstrates these differences.

| ***Table 2.7 Comparison of Discussion and dialogue*** | |
|---|---|
| Discussion/Debate | Dialogue |
| Breaking issues/problems into parts | Seeing the whole among the parts |
| Seeing distinctions between the parts | Seeing the connections between the parts |
| Justifying/defending assumptions | Inquiring into assumptions |
| Persuading, selling, telling | Learning through inquiry and disclosure |
| Gaining agreement on one meaning | Creating shared meaning among many |
| Source: (Ellinor & Gerard, 1998, p. 21) | |

Dialogue can be difficult to achieve in many western organisations which are primarily 'individualistic' and documentation-based (Golsby-Smith, 2001), where most information is written and then passed on for comment or response. In comparison collaborative forms of interaction based on "dialogue" are primarily oral, and designed to develop understanding through respectful interaction (Isaacs, 1999; Kettl, 2006).

### 2.7.2 Boundary crossing & objects:

The multiple frames associated with wicked problem are related to the thought collectives (Pohl, 2011) or knowledge cultures (V. Brown, 2008) of the different stakeholders involved in the problem. The differences between the thinking of each knowledge culture lead to boundaries around each stakeholder group that act as barriers to shared understanding (Akkerman & Bakker, 2011; Wenger, 1991). A boundary in this circumstance can be seen as "a sociocultural difference leading to discontinuity in action or interaction" (Akkerman & Bakker, 2011, p. 133). Boundaries are reinforced and made more explicit through the increasing specialisation of expertise (Akkerman & Bakker, 2011, p. 132; Wenger, 1991).

Two concepts identified as central for improving communication, dialogue and understanding between stakeholder groups are *boundary crossing* and *boundary objects* (Akkerman & Bakker, 2011, p. 133).

**Boundary crossing** refers to a person functioning across boundaries or within other domains; where stakeholders may need to "enter onto territory which [is] unfamiliar and to some significant extent therefore [they are] unqualified" (Suchman, 1994, p. 25). This leads to the development of *hybrid thinking*, which has been defined by the Gartner group (Gall, Newman, Allega, Lapkin, & Handler, 2010, p. 13) as "an organic discipline for taking on wicked problems by iteratively implementing transformative, innovative and strategic change via the co-creative exploration of human-centered experiences that are culturally meaningful, technically feasible and economically sustainable", and by Engestrom et al. (1995, p. 319), as "the challenge of negotiating and combining ingredients from different contexts to achieve hybrid situations."

Boundary crossing is a crucial concept for tackling wicked problems. The stakeholder groups in this study generally have limited involvement with each other's 'domains', their involvement during the LAND project providing some insight into the domains or territories occupied by other stakeholders. In general terms 'domains' refers to the work environment, culture and sphere of influence.

**Boundary objects** refer to artefacts that function as bridges between domains (S.L. Star, 1989). This type of object:

> "both inhabit[s] several intersecting worlds and satisf[ies] the informational requirements of each of them. . . . [It is] both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. [It is] weakly structured

in common use, and become[s] strongly structured in individual site use" (S. L. Star & Griesemer, 1989, p. 393).

Akkerman and Bakker's review of educational literature (2011) identified four mechanisms by which boundary objects can increase understanding across social worlds. Each mechanism has characteristics that support dialogical learning processes. Dialogicality is defined as "The ontological characteristic of the human mind to conceive, create, and communicate about social realities through mutual engagement of the ego (i.e., self or selves) and the alter (i.e., others)" and that understanding is "founded on 'dialogue' between different minds expressing multitudes of multivoiced meanings" (Akkerman & Bakker, 2011, pp. 136-137). These mechanisms and associated characteristics are shown in Table #2.8.

***Table 2.8 Boundary Object Learning Mechanisms***

| Dialogical learning mechanisms | Characteristic processes |
|---|---|
| 1. Identification | Othering<br>Legitimating coexistence |
| 2. Coordination | Communicative connection<br>Efforts of translation<br>Increasing boundary permeability<br>Routinization |
| 3. Reflection | Perspective making<br>Perspective taking |
| 4. Transformation | Confrontation<br>Recognizing shared problem space<br>Hybridization<br>Crystallization<br>Maintaining uniqueness of intersecting practices<br>Continuous joint work at the boundary |

Source: (Akkerman & Bakker, 2011, p. 151)

Identification here refers to raising awareness of stakeholder's own frames of meaning and acknowledging the legitimacy of other frames of meaning. Coordination is about practice and action, how stakeholders make communicative connections and begin the process of reflection and transformation. Reflection is key

to making explicit stakeholders' tacit understandings and considering alternative perspectives. Finally, transformation refers here to changes in thinking that lead to changes in practice. Transformation processes are important in a collaborative approach to tackling wicked problems, as they involve critically analysing relationships in systems and constructing meaning between stakeholders.

### 2.7.3 Shared visual space:

As the name suggests, shared visual space refers to physical spaces that can be shared visually between stakeholders (Conklin, 2005, pp. 46-49). This space acts as a boundary object (Conklin, 2005, p. 48) and may utilise different levels of technology from post-it notes and whiteboards (Straker, 1997) through to sophisticated virtual computer environments (Fox, 2011; J. W. Kelly, Beall, & Loomis, 2004). This type of boundary object is designed to improve understanding by allowing people to share a neutral conceptual space in which to work together during a dialogue. As described by Conklin (2005, p. 50), this space is shared, not owned by either one, but by both. The elements in this space are usually a mixture of graphics and text and are able to be changed, added to and removed as the dialogue between people continues.

Witteveen's (2009; 2010) work explores the role of this sort of visual space for "problem analysis and formulation of alternatives, focusing on dialogue and participation by social actors" (Witteveen, 2009, p. 8).

### 2.7.4 Mapping:

Various types of mapping have been used as boundary objects in a shared visual space for tackling wicked problems (Conklin, 2005, p. 48; Horn & Weber, 2007). Concept and causal mapping both provide a visual way of showing complex linkages

and relationships (Blackwell, 2001; Burke, et al., 2005; Hong, Shen, Losh, & Turner, 2007; D. Hyerle, 2000; D. N. Hyerle, 2008). Created or edited collaboratively, they also provide an effective way of surfacing assumptions and tacit knowledge as well as extending thinking. They can thus provide a highly functional shared visual space for supporting dialogue (Scavarda, Bouzdine-Chameeva, Meyer Goldstein, Hays, & Hill, 2004).

Causal mapping is a visual representation tool and a subset of concept mapping, a concept map being a "representation of an individual's perception of a particular topic" (J. Novak & Cañas, 2008; Scavarda, et al., 2004, p. 8). Causal maps have been defined by Novak & Cañas (2008, pp. 1-2) as

> graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts.

#### *2.7.4.1 Causal maps as representing objective reality*

Causal maps can display networks of causes, and may include causal loops, wherein each cause and effect link until the final cause feeds back into the original cause (Narayanan & Armstrong, 2005, p. 2). Causal maps are sometimes called "directed cognitive maps" (Narayanan & Armstrong, 2005, p. 12). The elements are the same as in concept mapping, where 'nodes' stand for concepts (causes), and links represent relationships or associations. However, as Vo, et al. (2005, p. 144) explain, the causal map "diagram is unique in that it allows for the creation of logical relationships leading into a cause."

Both cognitive mapping and causal mapping have been used for research in a wide range of settings in business and education (Bryson, 2004; Craig, 2000; Finn, 2004; Narayanan & Armstrong, 2005; Scavarda, et al., 2004) & (Blackwell, 2001; Conklin, 2005; D. Hyerle, 1996, 2000; D. N. Hyerle, 2004, 2008; Maal, 2001; J. Novak, 2010; J. Novak & Gowin, 1984; Trochim, 2006; Wilson, 2000). The results of causal mapping in research have been analysed in a variety of ways. (Vo, et al., 2005, pp. 144-147). These include:

(i) Quantitative methods

- Map complexity: The number of nodes, where the assumption is that more nodes equals greater complexity
- Map density: Links to nodes ratio; L:N=Density. The assumption here is that the more links between nodes, the more 'dense' or sophisticated the map is.

(ii) Subjective methods

- Adequacy of problem representation: How well does the map explain the complexity of the problem?
- Solution implications: Does the map address the potential outcomes of possible solutions?
- Degree to which maps capture different perspectives: How well do the individual maps represent each position, and are indications of alignment between alternative positions?

Both quantitative and subjective methods are generally used to attempt to assess a map's 'accuracy' in representing the 'reality' of the causes of the problem under investigation (Abernethy, et al., 2005). This study primarily employed subjective methods in the use of causal maps, but in a different manner.

### *2.7.4.2 Causal maps as representing subjective perceptions*

In this research causal maps are used as a representation of the thinking of individuals or groups, rather than an objective presentation of actual causes. This is explained by Abernethy et al (2005, p. 138) as a representation of an individual's personal knowledge and own work experience. Narayanan & Armstrong (2005, p. 8) explain that with "causal maps, the nodes are the constructs that the individual feels are important and the arrows show the relations among the constructs."

The mapping process encourages individuals to explain what they think, revealing facets of their underlying frame that were previously tacit, and of which they may have been previously unaware. All concept maps visualise knowledge and communicate this visualisation to self and others, thus converting tacit knowledge to explicit knowledge (Eden & Ackermann, 1992). Within this context, Narayanan & Armstrong (2005, pp. 2-8) argue that causal maps can be used for

- Brainstorming [see also (Bryson, 2004; Craig, 2000)]
- Problem diagnosis [see also (Edwards, 1989; Finn, 2004)]
- Converting tacit knowledge to explicit [see also Abernethy, et al., (2005, p. 137)]
- Organising, structuring and understanding a topic [see also Rico (2000)]
- Understanding and constructing meaning with individuals and groups of participants [see also Torres & Marriott (2010)]
- Analysing critical relationships in a system [see also (Hegedus, 2010)]

All of these are important for the use of causal maps as boundary objects supporting dialogue (Akkerman & Bakker, 2011), and therefore make them an effective tool for tackling wicked problems.

This section has provided an overview of the relevant collaborative concepts and tools that will be utilised for this study. Used within the context of dialogue, causal

mapping is a boundary object that can be used to represent the perceptions of stakeholders operating from different frames. This literature on wicked problems is seen as relevant to the specific topic of improving numeracy achievement in low socioeconomic status schools and that forms the focus of the next section of this review of the literature.

## 2.8 Overview of the LAND project

It is the contention in this study that tackling low numeracy achievement is an example of a 'wicked problem'. The issues involved are complex, with a wide range of stakeholder views about the nature of the 'problem', its causative factors, the means of tackling it, and the criteria used to judge whether it has been successfully addressed. The literature on numeracy achievement in low SES schools in this research is drawn from the work done by Gaffney and Faragher (2010; 2009, 2010, 2011) undertaken through the Leading Aligned Numeracy Development (LAND) Project. The LAND project was "a pilot initiative funded by the Australian Government to investigate the characteristics of numeracy teaching and learning, supporting elements at school and central office level, educational leadership capabilities, and system design principles that together can improve the numeracy achievement of students in low socioeconomic school communities" (Gaffney & Faragher, 2010, p. 1)

Although the LAND research did not initially use the term 'wicked problem', the project design utilised many of the characteristics of such problems mentioned in the policy literature. For example, diversity is recognised by including multiple stakeholders: principals and teachers at the school level, as well as project officers and program staff from the Catholic Education Offices (CEO), and staff from the Australian Government, in particular the Department of Education, Employment and Workplace Relations (DEEWR) (Gaffney & Faragher, 2010). The wicked nature of the problem is evident also in the variety of concepts under investigation. These

include the relationship between student achievement and socioeconomic status (SES) reflected in the position of Emerson, et al., (2008) that "The link between poverty and developmental delay has been established".

Further, elements that acknowledge the physical, logistical and temporal constraints of working in schools in both urban and remote environments are investigated in the project. Combining workshops with school visits and providing an online wiki for ongoing communication are designed to reduce the impact of these constraints. Having school teams participate in the project, rather than individual representatives, was designed to provide some continuity, against the instability caused by high staff turnover, typical of schools from low SES communities (Gaffney & Faragher, 2009).

The complexity and ambiguity of the multiple systems involved was identified and incorporated in the research design by the development of a LAND framework, (shown in Figure #2.7), that draws on multi-causal models of school improvement by authors Andrews et al (2004), Caldwell and Spinks (2008), Crowther et al. (2002), and the leadership capability framework developed by the ACU Flagship for Creative and Authentic Leadership (2007).

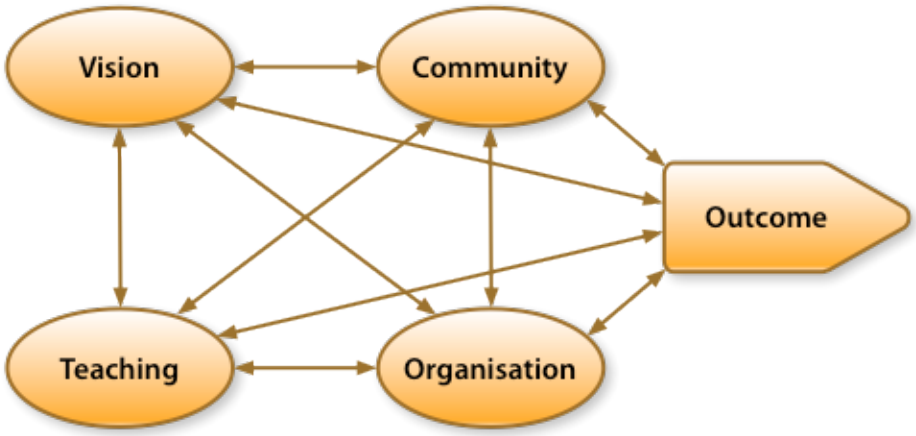


**Figure 2.7 The LAND Framework**

## 2.9 Chapter Summary

This literature review has presented and discussed research and scholarly writing related to the elements of this study. Policy was been defined using two heuristics that set the parameters of its usage for this research. The nature and characteristics of wicked problems have been clarified with a focus on the different 'frames' of the various stakeholders. Three different types of strategies used to tackle wicked problems were provided with a preference declared for 'collaborative' approaches as the only type that does not 'tame' this type of problem. Specific types of collaborative processes and tools were introduced that were used in the research activities. Finally, literature relating to the research underpinning the LAND project is reviewed. This included both the effects of poverty on schooling outcomes and literature related to developing numeracy in low socioeconomic status schools.

# 3 Tackling Wicked Problems: Professional Reflections

My professional experience in tackling wicked problems has been ongoing for about twenty years, through consulting with both private and public organisations. Clients hire consultants to 'solve' problems for them, or to identify and review the issues that have created the problem. In my consultancy, problems raised by clients and their stakeholders have ranged across many areas and topics, and have often led to recommendations related to policy. This chapter provides an overview of my reflections on my professional experiences of wicked problems so that the insights I have gained from decades of relevant work practice can be explicitly incorporated into this research.

My professional experience has shown that what is important is not only the substantive nature of the clients' problems but also their thinking and actions in identifying and trying to solve such problems.

Overall, my professional experience aligns with the literature on wicked problems, but there are some important differences. One example is in the use of terminology. Clients have described their problems in various ways, but until recently no-one has used the term 'wicked'. Instead they have used labels such as complex, confusing, intractable, messy, difficult and vague. Other differences, as well as similarities, between the policy literature and my professional experiences, are described in the following sections.

## 3.1 Stakeholder Perceptions: Symptoms, Not Characteristics

In my experience most stakeholders have difficulty in describing wicked problems in terms of specific characteristics or in providing an overview of the problem as a whole. Instead, some significant symptom becomes their focus for defining the

problem and for any request for help in finding a solution. This perceptual orientation is a crucial factor in how stakeholders make sense of their problems and seek to solve them (Weick, 1995, 2000; Weick & Sutcliffe, 2001). It also has wide ranging implications for the diagnosis, processes and tools used for tackling wicked problems.

Firstly, even if the problem is about policy it is often perceived or presented as procedural. Secondly, this orientation focuses effort on the symptoms more than the underlying, more complex causes. Finally, attempts to get clients to see the problem as more complex, or wicked, are often resisted and seen as an attempt by the consultant to generate more work.

Clients' expression of symptoms has generally corresponded to the reactions expected from the characteristics of wicked problems identified in the literature. Various types of symptoms of wicked problems may emerge, including people-related, systemic, and environmental or contextual. An overview of the types of symptoms, related literature and examples from my work experience will be presented in the following sections.

### 3.1.1 People related symptoms

People-related symptoms of a wicked problem presenting in an organisation may include psychological concerns such as frustration, confusion, anger, fear, anxiety and exhaustion. In some cases the toll on people has included mental breakdowns and attempted suicide. All of these psychological symptoms are reasonable if the people involved in the problem are facing various elements of wickedity, such as difficulty in defining the problem (Rittel & Webber, 1973), uncertain or missing data (Horn & Weber, 2007), resistance to change, and numerous intervention points

(APSC, 2007). Further, any attempted solution may cause other unforseen problems (Rittel & Webber, 1973).

Other people-related symptoms have to do with the consequences of different disciplinary paradigms or frames from which people operate. In some cases the intractable nature of some people's views on an issue present the biggest problem for a client (Horn & Weber, 2007). To illustrate, executives in one government department were concerned that their legal policy people were producing poor written work. On investigation the staff involved were convinced they were creating quality work, and felt that the executive wanted them to 'lower their standards', which they were not prepared to do. This aligns with the various characteristics of wicked problems discussed in the literature in Chapter 2. In particular, Horn (2007) focuses on the multiplicity of stakeholder frames or worldviews, meaning that a wicked problem contains multiple value conflicts and ideological constraints. This, in turn, leads to different and contradictory views on what the problem is, and what are acceptable solutions.

### 3.1.2 Systemic symptoms

As discussed in the literature review, many authors see uncertainty as a key feature of wicked problems. Head (2008c), for example, identifies uncertainty as one of three dimensions that make up wicked problems. My observation, however, is that uncertainty is a symptom and consequence of systemic ambiguity.

Organisations are social systems, and while some are straightforward and clear-cut in design and function, others can be very ambiguous or fuzzy (Argyris, 1999). Multiple meanings and evaluations often exist for the same system, and for interpreting terms, labels and consequences of action. There also can be a number of alternative processes within a system for achieving a given end (Ackoff, 1999;

Anderson, 2009). This can lead to confusion, or uncertainty, both within and outside the organisation.

An example of the outworking of this kind of ambiguity comes from a case where I noted confusion and frustration emerging between the different client groups half way through the second of five meetings. In working through this, we perceived that the members of the different client organizations, as well as myself, were not meaning the same things by the same words. Over the next two hours we defined twenty terms from the point of view of each of the stakeholder organisations. This reduced the level of ambiguity in a major way with a parallel drop in the level of the perceived wickedness of the problem.

Symptoms may also be expressed as a sense of being overwhelmed by the sheer complexity in a situation (Head, 2008b, 2008c), due to the multiplicity of issues, stakeholders, paradigms, interdependencies and potential consequences. Organisational inaction, in-fighting over political patches, conflicting and inconsistent policy and fragmented approaches to issues are also common (APSC, 2007; Bore & Wright, 2009; Boulton, 2010; Carpenter, 2009). In one case, a whole project had come to a halt. My investigation identified that five different sections had been given responsibility for the project, and this had led to gridlock between the various players.

I have also found that experts or people deeply involved in a specific issue are unaware of how much complex detail they hold in their long term memory (Richardson, et al., 1996). In almost every case of mapping a significant problem, participants have been shocked at how much was involved, and how much complex detail was, as it were, hiding in their minds (Atleo, 2008; J. Kelly, 2010; Trochim, 2006). As an example I used three glass walls in a meeting office to map a problem that had been unsolved for six months. The client commented, "no wonder I was having problems, I didn't know all that was in my head."

### 3.1.3 Environment or contextual symptoms

Some symptoms of wicked problems are seen as a manifestation of the issues related to the environment or context of the problem. This might include a massive rate of change, the historical legacy of the problem or timing concerns (e.g. impossible deadlines). These are typical characteristics that highlight the dynamic nature of wicked problems (APSC, 2007; Derbentseva, Safayeni, & Cañas, 2007; Gray & Gill, 2009).

Other contextual symptoms relate to the various types of constraints that impinge on the problem. Constraints may be people-related, e.g. political or ideological in nature, be due to a personal unwillingness to change, or involve systemic limitations in resources, knowledge or maturity of processes (Horn & Weber, 2007). Contextual symptoms can also include constraints related to time, environmental or economic factors, or availability of relevant data. Often the complaint is the arbitrary setting of completion dates for a project or solution.

Instability in the work environment creates other contextual symptoms. In my experience clients are often surprised by changes that may be caused by factors unexpected, not of immediate concern, or totally beyond their control. In a number of cases, severe weather events have contributed to making a problem more wicked. Continual change can also lead to fatigue and a desire to pretend that things are constant (Kotter, 1996; Lahey, 2002; Maginn, 2004).

## 3.2 Client Pressure To Tame Wicked Problems

In my experience as a consultant, clients rarely put symptoms together in some form of profile, seek to get to underlying causes, or consider the linkages between different parts of a problem. Rather the opposite has usually been true, to the extent that in a number of cases projects have been cancelled because of a concern that

what may come to light would be embarrassing or too confusing for the organisation. This attitude creates pressure to simplify descriptions of a problem and to design single focus, short-term solutions. In short the thinking and actions of clients is generally to try and tame policy problems rather than truly tackle them (Conklin, 2005, pp. 18-23).

This can be illustrated using an iceberg analogy. As shown in Figure #3.1 two different approaches, (A) and (B), are used to tackle the same problem. They start at almost the same place. (A) focuses only on the visible, surface symptoms and quickly returns a solution. (B) explores symptoms and then the underlying causes. This also produces a solution, but it takes more time and the two solutions may be quite different.

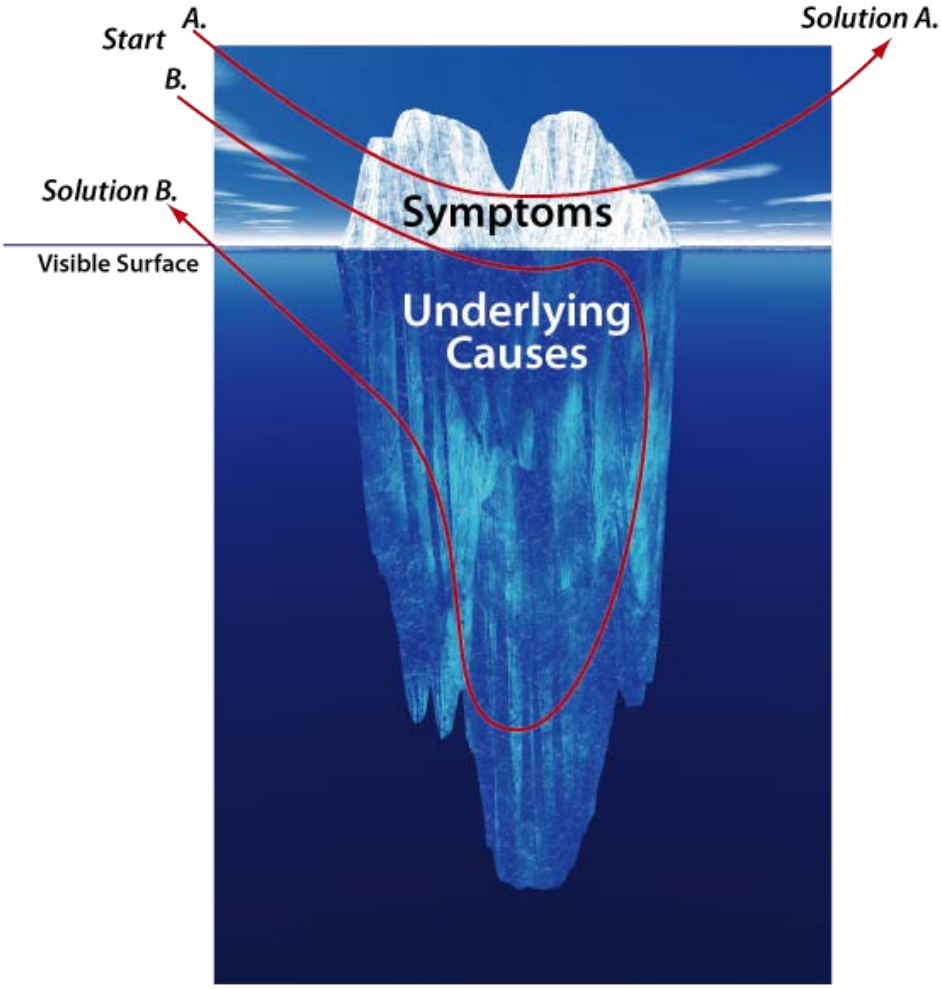


Figure 3.1 Two approaches to tackling complex problems

An example of how this has worked in practice comes from a project review that I conducted. An earlier, standard review had analysed project parameters and identified symptomatic issues relating to time constraints, project processes and technology factors. The primary conclusion drawn from this initial review was that the project process and technology choice needed to be refined. This made sense in light of the symptoms surveyed, but unofficial stories from the original project pointed to deeper issues that were not picked up in the standard review process. Consequently, the client decided to conduct a second review and was willing to expend considerable time and money to understand the complexities of the problem.

For this review I interviewed all the main stakeholders. A different, more complex story emerged. Stakeholders agreed with the previous review's symptoms, but both added to them and explained the underlying reasons for them. There were significant personal stress issues experienced by project members that were attributed to multiple overlapping causes, at the core of which were differing disciplinary frames. Confusion and frustration were the result of miscommunication and conflicting expectations that were indicative of differing meanings attributed to key concepts and structures of thought and process. These deeper issues made it clear that the project had many features of a wicked problem (APSC, 2007; V. Brown, et al., 2010; Hancock, 2010; Horn & Weber, 2007; Rittel & Webber, 1973; Schon, 1999) and that version #2 of the project would need to put in place collaborative structures that facilitated boundary crossing (Akkerman & Bakker, 2011) and cross disciplinary communication (Golsby-Smith, 2001; Smulders, Lousberg, & Dorst, 2008; Weber & Khademian, 2008).

## 3.3 Chapter Summary

In my experience clients perceive problems from a primarily symptomatic view rather than as a list of characteristics. These symptoms range across a number of work related areas including people, systems and the work environment. The number and complexity of pressures mean that most clients do not look deeper than these symptoms and tend to ignore underlying causes. This has created a professional challenge for me: how do I help clients to consider the multiple dimensions of wicked problems given their tendencies towards taming rather than tackling such problems?

One way to address this challenge is to develop and trial a framework that not only can be readily used and understood but also include the range of factors involved in wicked problems, identified in the literature and reflected in my professional experience. The nature of such a framework is the subject of the next chapter.

# 4 The Provisional Niche Wicked Problem Framework

It is a contention of this research that tackling wicked problems requires a usable synthesis of their disparate characteristics into a more functional framework. Therefore, on the basis of the literature and my reflections from over twenty years of experience as a consultant, a provisional framework for tackling wicked problems is proposed in this chapter. It is presented as a 'provisional' framework because it will be trialled against the data collected and analysed in this study.

The framework identifies three linked areas of potential wickedity, (people, systems and context), each with two related dimensions. Having a framework with only six dimensions should make it more memorable than the thirty two characteristics identified in Table #2.3 in the literature review. Each area (or loop in the related model, shown in Figure #4.1), relates to an emphasis in the literature. Some authors focus more on the systems-related issues (DeGrace & Hulet Stahl, 1990; Hancock, 2010), others on the people-related factors (V. Brown, et al., 2010; Ney, 2009; Schon, 1999), and a few have picked up on the contextual issues of constraint and instability (Aliseda, 1997; Burns, 2010; Camillus, 2008; Horn & Weber, 2007).

## 4.1 The Niche Wicked Problem Framework Model

The framework is titled the 'Niche Wicked Problem Framework' in recognition that much of this thinking has been a consequence of my work for my own company Niche Thinking. The visual form of the framework is based on a 'Gordian knot' motif, as shown in Figure #4.1, to represent the inter-connected nature of wicked problems. Each of the three 'loops' merges into the next, and the knot as a whole has no start or finish. This is to highlight that each of the areas is seamlessly linked to each other, demonstrating that while wicked problems can be better managed, they are never actually 'solved'.

People (Blue)

- Diversity
- Intractability

Systems (Green)

- Complexity
- Ambiguity

Context (Red)

- Instability
- Constraints


**Figure 4.1 The Niche Wicked Problem Framework**

The characteristics from Table #2.3 can be mapped onto the six dimensions of this framework as shown in Tables #4.1, #4.2 and #4.3.

| ***Table 4.1 APSC (2007) Mapped onto Niche Framework*** | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Characteristics | Intractability | Diversity | Complexity | Ambiguity | Instability | Constraints |
| 1 | Difficult to clearly define | | ✓ | ✓ | ✓ | ✓ | |
| 2 | Many interdependencies and multi-causal aspects | | | ✓✓ | | | |
| 3 | Proposed measures may have unforeseen effects | | | ✓ | | | |
| 4 | Problems may be unstable and continue evolving | | | | | ✓✓ | |
| 5 | No clear and correct solution | | | | ✓ | | |
| 6 | Problems are socially complex with many stakeholders | ✓ | ✓ | ✓ | ✓ | | |
| 7 | Responsibility stretches across many organisations | | | ✓ | ✓ | | ✓ |
| 8 | Solutions may require behavioural changes by citizens and stakeholder groups. | ✓ | ✓ | | | | |

| *Table 4.2 Rittel & Webber (1973) Mapped onto Niche Framework* | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Characteristics | Intractability | Diversity | Complexity | Ambiguity | Instability | Constraints |
| 1 | There is no definitive formulation of a wicked problem, i.e. even the definition and scope of the term is contested; | | ✓ | ✓ | ✓ | | |
| 2 | Wicked problems have no 'stopping rule', i.e. no definitive solution. | | | | | ✓ | |
| 3 | Solutions to wicked problems are not true-or-false, but good-or-bad in the eyes of stakeholders. | ✓ | ✓ | | ✓ | | |
| 4 | There is no immediate and no ultimate test of a solution to a wicked problem. | | | | | ✓ | ✓ |
| 5 | Every (attempted) solution to a wicked problem is a 'one-shot operation'; the results cannot be readily undone, and there is no opportunity to learn by trial-and-error. | | | | | ✓ | ✓ |
| 6 | Wicked problems do not have a clear set of potential solutions, nor is there a well described set of permissible operations to be incorporated into the plan. | | ✓ | ✓ | ✓ | | |
| 7 | Every wicked problem is essentially unique. | | | ✓ | ✓ | | |
| 8 | Every wicked problem can be considered to be a symptom of another problem. | | | ✓ | | | |
| 9 | The existence of a discrepancy representing a wicked problem can be explained in numerous ways. | | | | ✓ | | |
| 10 | The planner has no 'right to be wrong', i.e. There is no public tolerance of initiatives or experiments that fail. | | | | | | ✓ |

| *Table 4.3 Horn & Weber (2007) Mapped onto Niche Framework* | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Characteristics | Intractability | Diversity | Complexity | Ambiguity | Instability | Constraints |
| 1 | No unique "correct" view of the problem; | | ✓ | ✓ | ✓ | | |
| 2 | Different views of the problem and contradictory solutions; | | ✓ | ✓ | ✓ | | |
| 3 | Most problems are connected to other problems; | | | ✓ | | | ✓ |
| 4 | Data are often uncertain or missing; | | | | ✓ | | |
| 5 | Multiple value conflicts; | ✓ | ✓ | ✓ | | | |
| 6 | Ideological and cultural constraints; | ✓ | ✓ | | ✓ | | ✓ |
| 7 | Political constraints; | ✓ | | | | ✓ | ✓ |
| 8 | Economic constraints; | | | | | | ✓ |
| 9 | Often a-logical or illogical or multi-valued thinking; | ✓ | ✓ | | ✓ | | |
| 10 | Numerous possible intervention points; | | | ✓ | | | |
| 11 | Consequences difficult to imagine; | | ✓ | ✓ | ✓ | | |
| 12 | Considerable uncertainty, ambiguity; | | | | ✓✓ | | |
| 13 | Great resistance to change; and, | ✓ | | | | | |
| 14 | Problem solver(s) out of contact with the problems and potential solutions. | | | ✓ | ✓ | | ✓ |

Tables #4.1-4.3 show that some characteristics map onto more than one part of the framework. This is due to the interrelated nature of many of the characteristics, and consequently of the dimensions of the framework.

The following sections of this chapter provide definitions and descriptions of each of the three loops of the framework and the associated dimensions. They will show how the various parts of the framework relate to each other, and how the framework is used as a theoretical lens in this research.

## 4.2 The People Loop

People are central to what make problems 'wicked' (Horn & Weber, 2007; Ney, 2009). This loop is about stakeholders and includes the two dimensions of '**diversity'** and '**intractability'**. These dimensions relate respectively to the multiplicity of stakeholder frames connected to a problem, and to their capacity to adapt their thinking.

Both dimensions can be seen as relating to individuals but can also be applied to organisations such as schools, school systems and governments. These two dimensions are critical for establishing that a problem can be considered 'wicked'.

### 4.2.1 Diversity

Diversity refers to the number and variety of stakeholders and frames involved in a problem. All groups share certain commonalities between members that distinguish them from other groups. In wicked problems it is the differences in the groups' frames that are central. This is not just a difference in values or priorities, but in how the world is viewed, what are acceptable forms of evidence and what is legitimized knowledge (Head, 2008c). In the context of wicked problems the number of stakeholders is not as significant as the differences between them (Ney, 2009). A

few groups with strongly opposed values, competing over limited resources, may be seen to have a higher level of diversity than a large number of people from a similar culture with similar values. These differences in frames impact on how stakeholders define the problem, the outcomes they want, what interventions are possible and what consequences will be acceptable (Rittel & Webber, 1973; Schon, 1999).

Diversity in this sense features in the three representative lists of characteristics of wicked problems shown in Tables #4.1, #4.2 and #4.3. It encompasses the ideas of social complexity and multiple value conflicts that occur with competing frames. It also relates to Rittel and Webber's (1973) view that solutions to wicked problems are not 'true or false', but 'good or bad' in the eyes of stakeholders. Diversity can also be seen to relate to standard sociological factors such as age, social status, gender, ethnicity and education. People may also differ in their knowledge of the problem, with different people apprehending different parts of the problem and potential solutions (Horn & Weber, 2007).

### 4.2.2 Intractability

For some people and groups, change and compromise are normal parts of life. For others, their ideology is unquestioned, and quite fixed or intractable. In some cases organisations can be intractable when policies are deemed immovable. This intractability is the subject of the second dimension of the People loop.

Intractability has been defined as the quality of being stubborn, hard to deal with or control (Delbridge, 2005). In this provisional framework it relates primarily to the frame positions of stakeholders but can also refer to the resistance to solution of the problem as a whole (Rittel & Webber, 1973). "Wicked problems tend to be intractable and elusive because they are influenced by many dynamic social and political factors as well as biophysical complexities" (Batie, 2008, p. 1176).

Head (2008b, p. 105) has noted that a key challenge in tackling wicked problems is to "unpack and discuss entrenched differences." He offers a detailed comparison of more tractable conflicts with more intractable ones, as shown in Table #4.4.

| ***Table 4.4 Comparison of tractable and intractable conflicts*** | | |
|---|---|---|
| | More Tractable | More Intractable |
| Parties | *Bounded*<br>Well-organised<br>Clearly defined members' roles & mission | *Diffuse*<br>Unorganised<br>Loose collective members' roles & mission<br>Lacking structure |
| Issues | *Consensual*<br>Agreement on values<br>Disagreement on allocation | *Dissensual*<br>Fundamental value differences |
| Social System | *Prescribed*<br>Well-defined structures<br>Clear procedures and rules<br>Legitimate authority | *Ambiguous*<br>Ill-defined structures<br>Uncertainty in procedures<br>Absence of clear authority |
| Conflict Process | *De-escalated*<br>Contained and focused<br>Commitment to resolving issues<br>Conflict cycles broken up | *Escalated*<br>Growth in parties, issues & costs<br>Polarisation & segregation<br>Conflict spirals |
| Source (Putnam & Wondolleck, 2003, p. 45) as quoted in (Head, 2008b, p. 105) | | |

## 4.3 The Systems Loop

The systems loop is focused on the dynamic relationship between inputs, processes and outputs and includes dimension #3, **'complexity',** and dimension #4, which has been labelled **'ambiguity'**. These two dimensions are also well represented in the literature (APSC, 2007; Head, 2008b; Horn & Weber, 2007; Kantor, 2011; Schon, 1999).

### 4.3.1 Complexity

For the purposes of this research, complexity is defined in accordance with Peter (1998). He defines a complex phenomenon as one that

I. consists of many parts (or items, or units, or individuals)

II. has many relationships/interactions among the parts; and

III. produces combined effects (synergies) that are not easily predicted and may often be novel, unexpected, even surprising.

The key to complexity is the level of intricacy of the whole 'mess' (Ackoff, 1974; Ney, 2009). Unlike diversity, which pertains to the differences between the various stakeholders, important factors in complexity are the sheer number of elements and the multiplicity of intricate details. In many wicked problems everything seems to be causally linked to everything else and therefore any attempt to intervene in one area may cause unpredictable consequences throughout the system.

### 4.3.2 Ambiguity

In relation to wicked problems, ambiguity is used in a range of ways. At its core is the sense of multiplicity (V. Brown, et al., 2010; Schon, 1999), fragmentation (Conklin, 2005), uncertainty (Head, 2008b)and vagueness or fuzziness (Jetter & Schweinfort, 2011; Sharif & Irani, 2006; Wiek & Walter, 2009) of meaning, authority, technology, goals or action (Jarzabkowski, Sillince, & Shaw, 2010). Giroux (2006, p. 1228) introduces the concept of 'pragmatic' ambiguity "as the condition of admitting more than one course of action." Weick (1995) presents ambiguity in organisations as the support of different interpretations at the same time. While Jarzabkowski, et al., (2010, p. 220) describe ambiguous goals as having "multiple, indistinct, incoherent or fragmented meanings, in which no single meaning is the 'best' or most coherent interpretation." All these definitional elements are pertinent to this study.

Ambiguity in wicked problems may be caused by

- Lack of or uncertain data (Horn & Weber, 2007)
- Different interpretations of terms and data (Schon, 1999)
- Contradictory underlying cultural meanings (Rittel & Webber, 1973)
- Uncertainty due to instability in the problem or environment (Borko, Whitcomb, & Liston, 2008)
- Responsibility stretching across multiple organisations (APSC, 2007)
- Multiple valid meanings (Rittel & Webber, 1973; Schon, 1999)
- Vagueness (Jetter & Schweinfort, 2011)
- Ambiguous contexts, characterized by multiple constituents, diffuse power and diverse interests (Jarzabkowski, et al., 2010)

Authors differ on whether ambiguity helps or hinders when tackling wicked problems. Some see it as an obstacle to solving problems because "participants will engage with the ambiguity of a situation differently according to their different interests and meanings, leading to multiple ways of conceptualizing strategic action" (Jarzabkowski, et al., 2010, p. 221). Others think ambiguity can be helpful because "any concept must necessarily lend itself to various interpretations to stand a chance of broad dissemination. The interpretative viability allows that different parties can each 'recognize' their own version of the concept. These parties may thus accept and embrace a concept because they see it as being beneficial to their interests" (Giroux, 2006, p. 1228). This has been called 'pragmatic ambiguity' (Giroux, 2006) or 'strategic ambiguity' by authors who have seen advantages in the deliberate use of ambiguity by stakeholders (E. M. Eisenberg, 1984, 1998; Eric M. Eisenberg, 2001; Jarzabkowski, et al., 2010).

## 4.4 The Context Loop

The third area in the model relates to the context of the problem and includes dimension #5, **'constraints'** and dimension #6, **'instability'**. Key references from policy literature include Basadur, et al. (2007a); Camillus (2008); Horn & Weber (2007); Schon (1999)and Soares (2010).

### 4.4.1 Constraints

A constraint refers to anything that restricts or limits actions or alternatives. Constraints may be political, environmental, chronological or ideological (Horn & Weber, 2007). They can also include limitations in resources, knowledge and willingness to change (APSC, 2007). Some authors have seen constraints as critical in creating 'super wicked problems' such as climate change (Lazarus, 2010; Soares, 2010).

### 4.4.2 Instability

Instability refers to the dynamic nature of wicked problems; the level of change in and around the problem itself. The APSC (2007) considers that by nature wicked problems "may be unstable and continue evolving." In many cases those caught up in the change have no control over what is happening or may even find themselves as contributing to some of the changes. In the context of wicked problems, instability may include changes in the environment, in the constraints related to the problem, in stakeholder's thinking, or in any other dimension or factor involved in the problem.

## 4.5 Framework Dimensions: Linkages And Interconnections

The three areas and six dimensions of the framework are linked and interrelated. The shape of the framework is designed to represent this interconnectedness. The

people, context and systems loops are connected in various ways. For example, increasing diversity among stakeholders increases the complexity of the problem (Head, 2008b). Their different ways of viewing the problem lead to different interpretations of ideas, terms, and concepts making any inherent ambiguity greater (Tegarden, et al., 2007). This ambiguity can then lead to increased intractability of stakeholder positions as each group use their own views to justify their position.

A second example is the connection of the 'context' and 'system' loops in relation to the problem's setting. Problems are harder to tackle if the context is unpredictable and changing. Constraints reduce the options for tackling the problem and are exacerbated by the ambiguity of the issues involved. Furthermore, constraints for one set of stakeholders may not matter or be perceived the same way for other groups.

## 4.6 Chapter Summary: The Niche Framework As A Theoretical Lens

The Niche Wicked Problem Framework is based on a synthesis of relevant policy research literature, and is supported by my professional experience. It is proposed as a **theoretical lens** for conducting the research and analysing the data. According to Creswel (2009, p. 62) a theoretical lens "provides an overall orientation... that shapes the types of questions asked, informs how data are collected and analysed, and provides for a call for action or change".

In this research the framework has been trialled to examine the extent to which it:

1) is both comprehensive and coherent in capturing the range of stakeholder thinking and actions on wicked problems

2) can be used to explain research findings about wicked problems; and

3) provides support in diagnosing and tackling wicked problems (Narayanan & Armstrong, 2005, p. 3).

The nature and extent of the wickedity of policy problems can be assessed by determining how many dimensions are involved in the problem, and to what extent. As more dimensions become involved in a problem, the problem becomes more wicked.

The nature of wicked problems means that stakeholders need to gain a worthwhile picture of 'the whole' for any positive action to take place. The ambiguity of wicked problems requires that stakeholders understand the various alternative meanings of key terms and concepts. Any process in tackling wicked problems must therefore involve stakeholders clarifying and sharing these understandings. This may result in reconceptualisation and lead to a different view of the problem, which in turn may require further clarification. The process can be readily appreciated as a non-linear set of interactions (Conklin, 2005).

The research tools proposed for this research are designed to enable this type of stakeholder interaction and reconceptualisation. The process is designed to encourage participants to engage with the problem of tackling low levels of student numeracy achievement in new ways. With this in mind I turn to the research design in the next chapter.

# 5 Research Design

## 5.1 Introduction

Wicked problems involve multiple stakeholders and require multiple perspectives to tackle them successfully (V. Brown, et al., 2010). Consequently, a broadly constructivist approach, focused on the "meaning-making activity of the… mind" (Crotty, 1998, p. 58), will be utilised with a general ethnographic methodology. This involves relational interaction to find out what each group of stakeholders is thinking and how they make sense of the problem (Weick, 2000). Thus, this qualitative research "helps us recognise and treat the fluidities, leakages and entanglements that make up the hinterland of research" (Law, 2004, p. 41).

Within this constructivist approach, the literature identifies collaborative methods for tackling wicked problems as the most useful for helping stakeholders to reach a shared understanding of the problem (Min Basadur, et al., 2000; J. Brown & Isaacs, 2005; Golsby-Smith, 2001; Torres & Marriott, 2010). Therefore the research instruments chosen are collaborative in nature and designed to enact multiple elements of the wicked problem framework and as such provide the greatest leverage and synergy from the participants' involvement.

## 5.2 Methodology

An ethnographic research methodology was adopted in this study. This involved an "in-depth qualitative analysis of an intact cultural scene" (Borg & Gall, 1989, p. 387), and employed the use of an "interactive subjectivity framework" (Adams, 1990, p. 342). Main elements of this perspective include

- a focus on perceptions of a total situation,

- a non-judgmental orientation with an emphasis on recording a situation without superimposing one's own value system, and
- contextualisation, where all data is considered in the context of the environment within which it was gathered.

The qualitative research methodology was based on the premise that participants were both fully informed and in some respects collaborators in the research activities (Yin, 2011). This research was focused on what the participants believe are the causes and causal linkages that are required to improve numeracy in their schools.

A second methodology, from within the constructivist approach, drawn on for this research, is grounded theory (Morse, et al., 2009). Since this study utilises a provisional wicked problem framework, based on policy research literature and personal professional experience, it would be incorrect to claim that grounded theory is a core methodology in this work. This is because, as Noerager et al. (2009, p. 68) have said, "using grounded theory is to develop a theory, grounded in data gathered during a given study, rather than testing theory developed by other scientists". However, there are a number of underlying assumptions and concepts involved in grounded theory that align with the research approach taken in this study. Firstly, as Morse (2009, p. 14) has stated, grounded theory "is a way of thinking about data." Second, the use of collaborative mapping and observation as research instruments, act "as tools to get at varied constructions or competing definitions of the situation" (Charmaz, 2010, p. 180).

Morse, et al (2009, pp. 38-44) lend further support to the use of grounded theory in this type of research in noting that

- there are multiple 'realities' and collecting and analysing data require capturing and taking into account those multiple viewpoints,

- it is not the event that is the focus of study but the meaning given to the event and the actions/interactions/emotions expressed in response, along with the context in which those responses and event occur; and that
- in the beginning of the analysis, the researcher does not know with any certainty the degree of significance of early concepts.

So, although there is a provisional analytical framework for this study, what participants will construct and make explicit to make sense of their 'wicked problem' is not known and will emerge from the interactions between stakeholders. This in turn will inform the processes of validation and refinement of the Niche Wicked Problem framework.

## 5.3 Research Instruments

Three groups of stakeholders (school, central office and government) participated in the research. These stakeholders were available for limited times over the period of the study. As a consequence, the research instruments were designed to enact multiple elements of the Niche Wicked Problem Framework and provide the greatest leverage and synergy from the participants' time and collaboration. The research instruments included:

- Surveys
- Observation
- Focus groups, incorporating a facilitated and collaborative causal mapping process, that utilised open ended questions

### 5.3.1 Surveys

The research used data collected from the surveys sent to each stakeholder group as part of the LAND research project. These surveys contained the following questions:

- What are the obstacles to improving numeracy in your school?
- What opportunities are there for improving numeracy in your school?

Copies of the survey instruments are presented in appendix #1.

### 5.3.2 Observations

The researcher's involvement as a member of the LAND project team provided opportunities to observe participants in workshop environments as well as in school settings. Both of these settings provided an appropriate base for this type of qualitative data collection (Yin, 2011, pp. 130-132). Each member of the LAND research team made observational notes, and project workshops were videotaped for later analysis. These recorded observations were aimed at identifying critical themes and elements that emerged from the workshops, discussions, and what had been seen and heard by researchers.

### 5.3.3 Focus groups

The focus groups (Yin, 2011, pp. 141-142) took place during workshops associated with the LAND project. There were four school cluster groups and three catholic education office (CEO) groups. The Australian Government also provided one group of public servants from the Department of Education, Employment and Workplace Relations (DEEWR). Each group met after the initial surveys and was provided with feedback on survey data. This process included sessions on developing causal maps.

### 5.3.4 Collaborative causal mapping

Causal maps were the primary research instrument in this study. They provide a visual way of showing complex linkages and relationships (Blackwell, 2001; Burke, et al., 2005; Hong, et al., 2007; D. Hyerle, 2000; D. N. Hyerle, 2008). Created or edited collaboratively, they also provide an effective way of surfacing assumptions and tacit knowledge, as well as extending thinking (Ackermann & Eden, 2005; Eden & Ackermann, 1992). They can provide a highly functional shared visual space for supporting dialogue (Scavarda, et al., 2004).

In this research causal maps are used as a representation of the thinking of individuals or groups, not an objective presentation of actual causes. This is explained by Abernethy et al (2005, p. 138) as a representation of an individual's personal knowledge and own work experience. Narayanan & Armstrong (2005, p. 8) explain that with "causal maps, the nodes are the constructs that the individual feels are important and the arrows show the relations among the constructs".

The mapping process encourages individuals to explain what they think, revealing facets of their underlying frame that had been tacit, and of which they may have been previously unaware (Eden & Ackermann, 1992). Causal mapping done in this way has attributes that make it a particularly effective tool for tackling wicked problems. Used within the context of dialogue, causal mapping can act as a boundary object that can be used to represent the perceptions of stakeholders holding different frames.

## 5.4 Ethical Considerations

As this research is part of the LAND project the ethical parameters have been placed within the boundaries and principles of that project. Ethics approval was granted by the ACU Human Research Ethics Committee (HREC) with register number N2009 4, dated 11 May 2009.

## 5.5 Individual Participants

Access to representatives from each of the groups involved was the primary determinant in deciding who would be a participant in this research. Stakeholders were restricted to those who were directly involved in the LAND project. There were three layers of stakeholders who acted as participants over five sites. All participants were linked to the LAND project. Each research site consisted of a cluster of schools together with a central office i.e. a Catholic Education Office (CEO). Each school cluster included a principal and up to three teachers. The offices of the Department of Education, Employment and Workplace Relations (DEEWR) in Canberra, ACT, were also considered as a research site for the purposes of this study. The layers of stakeholders are shown in Table #5.1.

| ***Table 5.1: Layers of education system participation*** | |
|---|---|
| Layer 1: Schools | South Australia (Adelaide) – 4 Urban Catholic primary schools. (SAU1-4)<br>Northern Territory – 5 Remote Indigenous Catholic Community Schools (NTR1-5)<br>Western Australia (Perth) – 4 Urban Catholic primary schools (WAU1-4)<br>Western Australian (Kimberley) – 4 Remote Catholic schools (WAR1-4) |
| Layer 2: System | At the system level three Catholic Education Offices (CEO) were involved.<br>South Australia – (SACEO)<br>Northern Territory – (NTCEO)<br>Western Australia – (WACEO) |
| Layer 3: Government | This layer consists of one group of federal public servants from DEEWR with interest in LAND and other similar research projects. (DEEWR) |

## 5.6 Participant Groups

Since wicked problems are characterised by multiple stakeholders, each perceiving the problem in their own way, the more stakeholders who can be engaged in the process of tackling the problem the better. The number of stakeholders linked to improving numeracy in low socioeconomic status schools in Australia, and in the LAND project in particular, is potentially very large. A concern for this study, therefore, was how to include a representative collection of stakeholders in a manageable form. Brown's (2008, pp. 29-37) model of grouping stakeholders involved in wicked problems around 'knowledge cultures', provided a solution. She identified five types of knowledge cultures related to wicked problems: individual, local, organisational, strategic and holistic (V. Brown, et al., 2010, p. 70). Each knowledge culture has its own "knowledge content, mode of collecting evidence, tests for truth, language and ways of rejecting others" (V. Brown, 2008, p. 31). Participants in this research belong to one or more of these knowledge cultures. The following sections provide a brief description of each of these knowledge cultures and the research participants included in them.

### 5.6.1 Individual knowledge: Own lived experience, identity

Each individual perceives the wicked problem from their particular position, building their response "out of their own lived experience, shaped by their social and physical setting" (V. Brown, 2008, p. 31). Therefore we should expect the findings to reflect these differences. Thus from the individual knowledge perspective we could include students, teachers, executive and administration from schools and parents, family and individual community members from the school locality. Since the scope of the LAND project is focused on educational professionals, participants were limited to individuals from schools, CEOs and federal departments. The non-involvement of students, families and other community members is a delimitation in this research.

### 5.6.2 Local community knowledge: Shared lived experience

Collectively the individuals connected to the school have a "shared lived experience" (V. Brown, et al., 2010, p. 70) that is distinct from just individual knowledge. This local knowledge is important for identifying contextual issues relating to particular school communities. The school cluster participants provide adequate representation, but this could have been improved had there been access to students, families and community members.

### 5.6.3 Specialist knowledge: Disciplinary expertise, professions

This group includes the 'experts' (V. Brown, 2008, p. 33) from disciplines that have links to the school, such as education academics who specialise in mathematics and leadership, other mathematics experts or consultants, as well as health and youth-related experts and consultants. In this study, disciplinary expertise (in the areas of mathematics and educational leadership) was primarily provided by the LAND project team members. These experts did not participate in the causal mapping but are included in the observations taken during the workshops.

### 5.6.4 Organisational knowledge: Governance, policy, legislation

This includes all those groups involved in governance, policy development and administering the systems that impact on the schools (V. Brown, et al., 2010, p. 72). In this research, relevant stakeholder groups under this category are the school as an organisation, Catholic Education Office (CEO) and related education providers, as well as relevant state level government agencies (including education, health and youth and similar agencies) and departments at the federal level. Participants with organisational knowledge for this study come from the CEO and federal government department and were directly involved in the causal mapping activities.

### 5.6.5 Holistic knowledge: Essence, core of the matter

Holistic knowledge is concerned with the process of tackling the problem and considering the whole (V. Brown, et al., 2010, p. 72). In this research, stakeholders in this category include the LAND research director and myself, as a LAND research member (with a specific focus on investigating alignment of the thinking and actions of stakeholders at school, central office and government levels), and includes those stakeholders with a focus of inquiry into the core of the issues.

The types of research participant in each knowledge group are summarised in Table #5.2.

| ***Table 5.2: Knowledge Groups As Research Participants*** | |
|---|---|
| Individual knowledge | Three levels of participants (School, CEO and government) |
| Local community knowledge | In a limited form by the teachers and principals but this group is lacking in representation. |
| Organisational knowledge | Principals, CEO, some LAND team members with links to the CEO. |
| Specialist knowledge | Represented by the LAND team members, both those from the Australian Catholic University and the CEO consultants operating in a liaison capacity for the project. This also included consultant members of the ACU research team, including who was a freelance maths and ITC consultant as well as a high school teacher. |
| Holistic knowledge | This group is limited in representation but includes the research director and myself. |

Considering Table #5.2, three of the five knowledge groups were well represented providing a range of relevant participants for the study. The methods detailing how data was collected from the participants of each knowledge group are described in the next section.

## 5.7 Data Collection

Data was collected during three rounds linked to stage 2 and 3 of the LAND project.

The stages of the project are summarised in Figure #5.1.

### 5.7.1 Stage 1 – Project Orientation, Information Gathering and Analysis

This stage involved:

- Familiarisation visits by the ACU team to schools including community consultation
- LAND Orientation Workshop with school personnel- principal and other staff (March/April, 2009)
- Gathering baseline information about current school and system numeracy practices

### 5.7.2 Stage 2 – Professional and Organisational Development

This stage involved:

- LAND workshops – 2 three day workshops (September, 2009 and April, 2010). These workshops will focus on: Pedagogy and Content Knowledge in Numeracy; Leadership; and School Development and Alignment.
- Visits by the ACU team to each school in the project at least twice between May 2009 and August 2010. Additional visits will be made by the CEO project officer.
- A mid-project review

### 5.7.3 Stage 3 – Planning for Sustainability

This stage involved:

- A final visit to each school in the project
- LAND showcase conference (including a planning and evaluation workshop) involving participants from NT, SA and WA projects (November 2010)
- Whole-of-project review and production of the final report

**Figure 5.1 LAND Project Stages**

Round one included the survey and the development of the initial causal maps. Round two involved the first causal mapping sessions conducted during Stage #2 of the project. Round three occurred during Stage #3 of the project and included the second causal mapping sessions. The data collection activities that took place during these rounds are described in the following sections.

### 5.7.4 Initial survey

School participants were asked to complete a survey at the start of the project. The survey questions were:

- What are the obstacles to improving numeracy in your school?
- What opportunities are there for improving numeracy in your school?

The Catholic Education Offices (CEOs) and DEEWR were provided with the survey two weeks prior to their workshops. The surveys for these stakeholders were customised, with the two questions listed above changed to be more generic:

- What do you see as significant **obstacles** to improving student achievement (e.g. literacy and numeracy) in low SES school communities?
- What do you see as significant **opportunities** for improving student achievement (e.g. literacy and numeracy) in low SES school communities?

Answers to these questions were extracted from the completed surveys, combined, and then used to create a causal map for each stakeholder group. Each map represented an initial collection of perceived causes required to improve numeracy in their stakeholder context. For ease of comparison, causes were grouped according to the LAND framework. If causes were linked in the survey responses, this was shown on the map by a line with an arrow. An example of how this was done is shown in Figure #5.2.

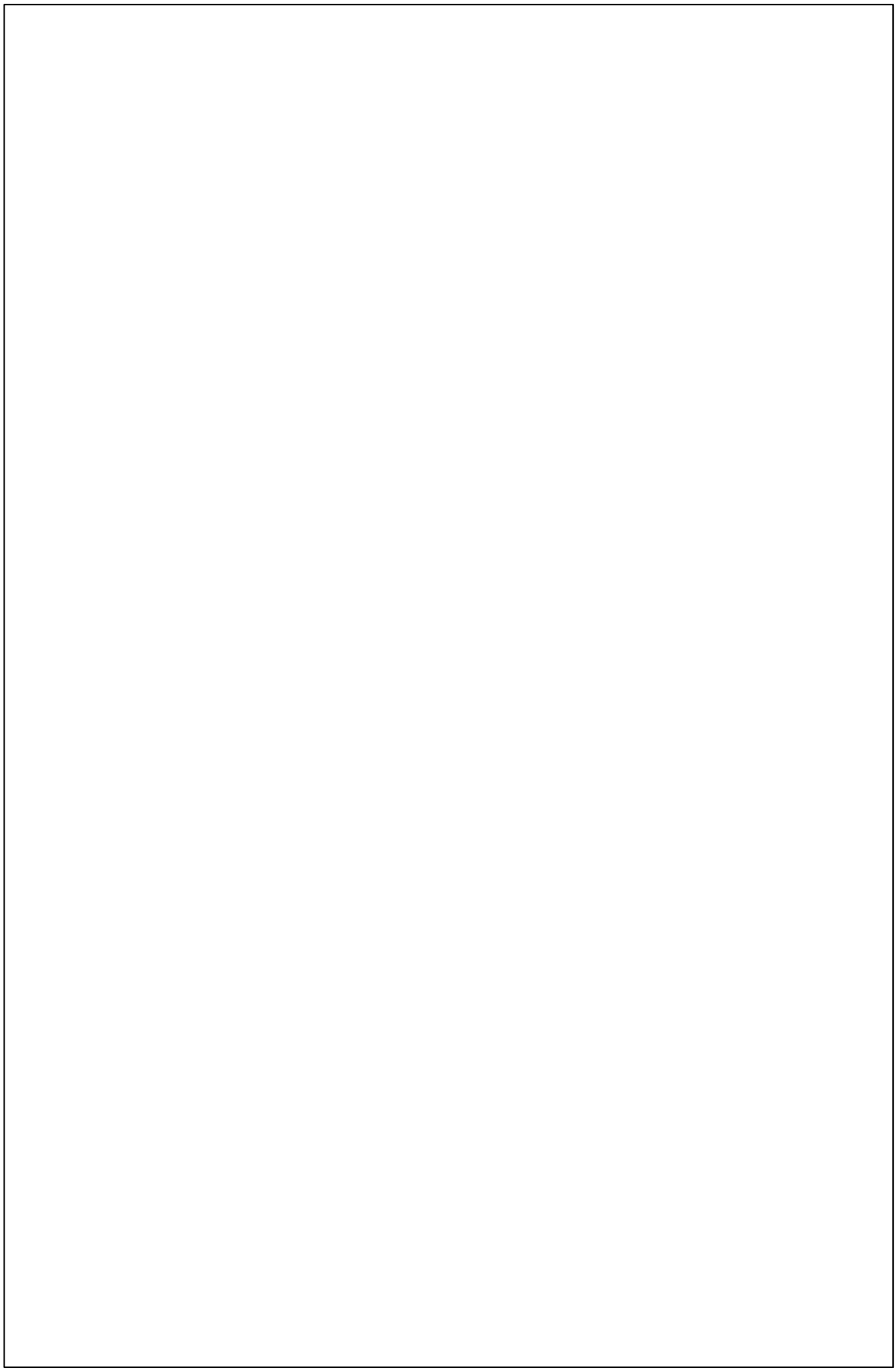

Figure 5.2 Example Initial Causal Map

### 5.7.5 Initial casual mapping sessions

Each cluster map was printed and presented to the related cluster group at Workshop #3 in the series of LAND project workshops. This enabled the collection of perceived causes to be reflected to the authors in a visual form as a representation of their collective thinking. Two ninety-minute sessions in Workshop #3 functioned as the first round of work on causal mapping. In the first session, participants were asked to reflect on their map in school groups. Groups were asked to respond to a series of questions through dialogue and collaborative modification of their maps. Each group's response was then reported back to the whole cluster.

The first set of questions asked were

- Is there anything we need to remove from the map?
- Is there anything missing that should be added?

Groups were then asked to discuss and report back the top three causes essential for improving numeracy in their schools and give reasons for their choices.

The focus of the second 90-minute session at Workshop #3 was the creation of causal maps by individuals. After an introduction on the nature of causal maps and how they are created, each participant was provided with an A3 sheet of paper and asked to create a map in line with the following instructions:

By yourself,

- Pick a cause important to you.
- Think 'how' does this lead to improved numeracy
- Add causes
- Add links

Following their individual work, participants were asked to form groups of two or three, and discuss each other's maps explaining what they had created and why. Each partner was then asked to make changes or additions to the other person's map in another colour. When time allowed, another round of pairings, discussion and modifications were made. An example of this process is shown in Figure #5.3. The original participant's work is in blue, a second person's response in black and a final addition from a third person is in red.

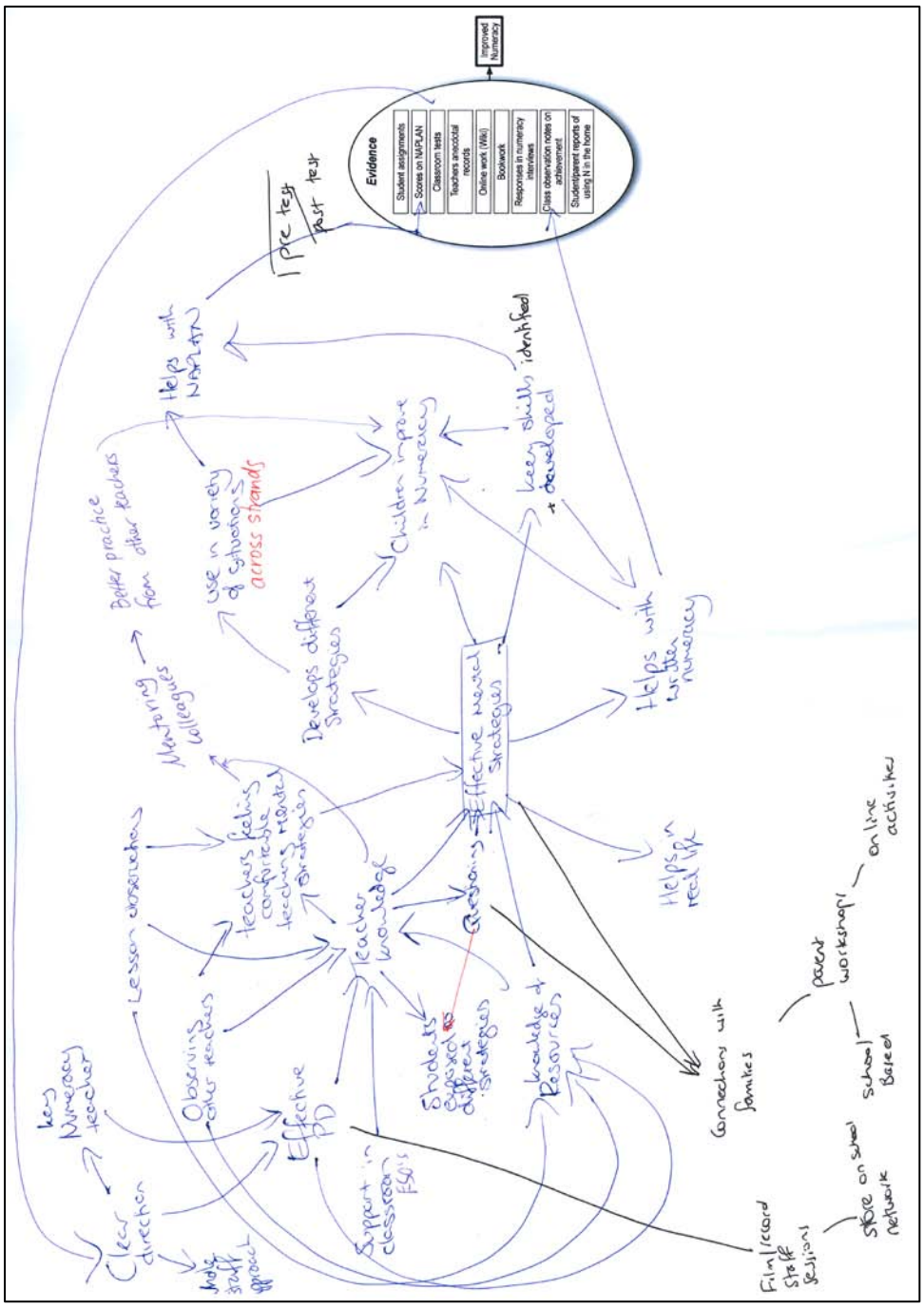


Figure 5.3. Completed individual causal map SAU1-3

At the end of the sessions all maps were collected and copied, with originals returned to participants. After each cluster Workshop #3 was completed, copies of participant maps were scanned and stored electronically for later analysis.

### 5.7.6 Follow-up causal mapping sessions

A comparative analysis was conducted in preparation for the second round of collaborative work to be performed at Workshop #4. These were the final workshops for school clusters and combined the clusters into two large groups. South Australia (SA) and Northern Territory (NT) clusters combined for one of the workshops, and the Broome and Perth clusters were combined for the other.

The content from the Workshop #3 group maps was combined and then added to the original electronic map. These revised maps were presented to school cluster groups for comment along with some basic information comparing the clusters. The workshops sessions included

- Reflection on combined maps
- Revisiting cause and effect
- A review of the map of top three causes for linking and adding comment
- Questions for group comment (see Appendix #2, Pathways to improve numeracy)

Participants were seated in school groups for the first part of the session that involved linking the top three causes, but were then invited to form groups with others of shared interest, for comments on the map comparisons.

The maps provided to participants contained the collection of top three causes identified by the relevant clusters in Workshop #3. School groups were asked to link the causes in any way that made sense to them, and then comment on those

links on the maps. A sample map from the Western Australia (WA) workshop is shown in Figure #5.4.

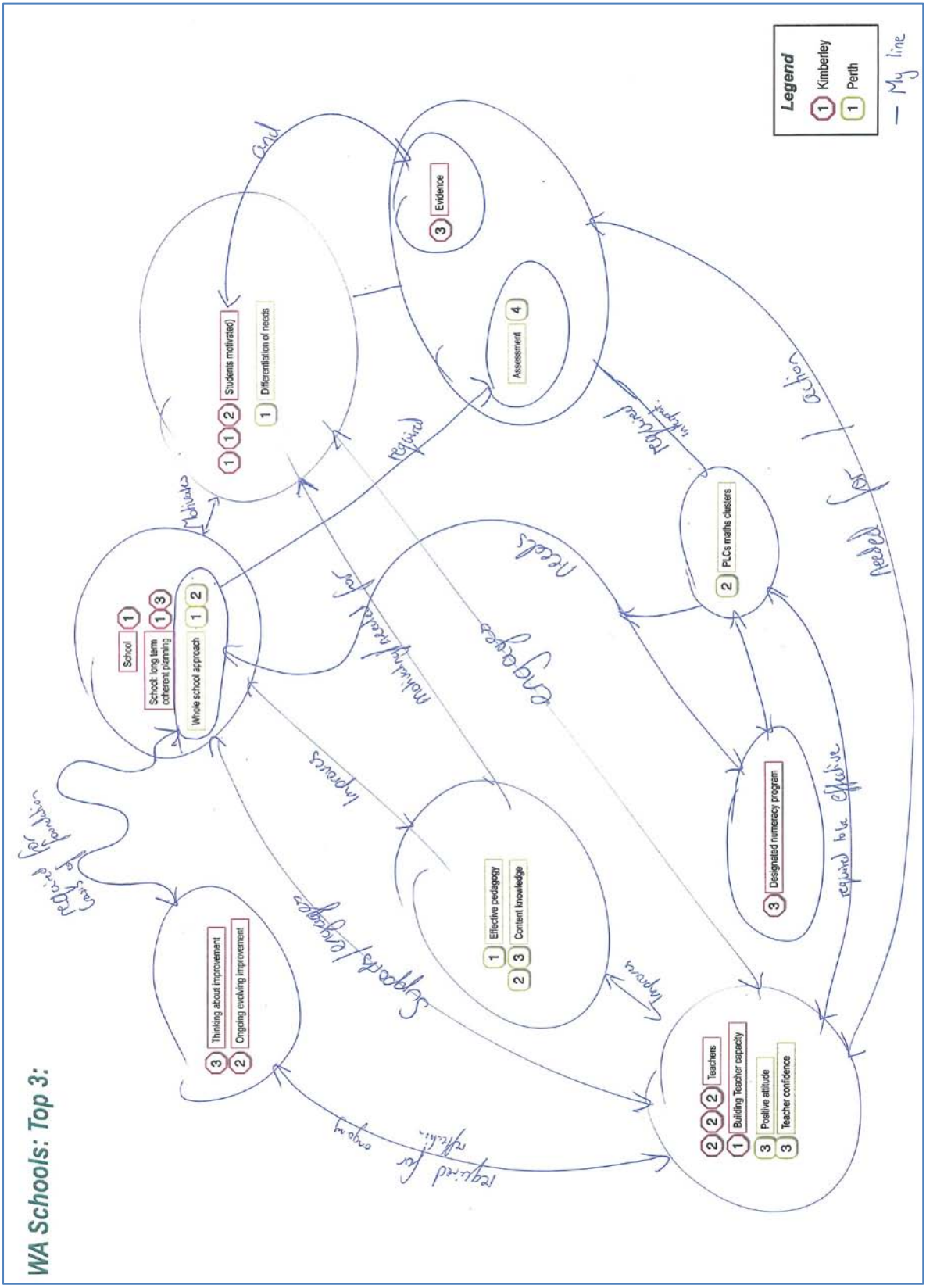


**Figure 5.4 Sample Causal map from final workshops**

## 5.8 Chapter Summary

This chapter has provided an overview of the general constructivist approach, utilising a broadly ethnographic methodology that is appropriate for this research given the nature of wicked problems and the diversity of participants involved.

Collaborative methods for tackling wicked problems were chosen as the most useful for helping stakeholders to reach a shared understanding of the problem. The initial survey information was used to provide a foundation for the facilitated causal mapping sessions in Workshops #3 and #4 of the LAND project. These instruments provided the research data to be used for answering the research questions.

The next two chapters present the findings from this study and apply these findings to the Niche wicked problem framework.

# 6 Findings

## 6.1 Introduction

The findings for this study focus on the perceptions of various stakeholder groups (school-based teachers and principals, central office personnel and government officers) regarding the nature of the 'wicked problem' of low levels of numeracy achievement among students attending schools in low SES communities.

Presentation of these findings provides answers to the first two threads of research questions noted in chapter #1:

- What are the patterns of causes shown by each stakeholder group, as they relate to improving numeracy?

- Does the collaborative workshop process, using causal maps, improve participants' understanding of the wickedity (Bore & Wright, 2009, p. 254) of the problem?

This chapter answers these questions through two sections and then analyses the findings further in chapter #7 by applying the Niche Wicked Problem framework to the results from chapter #6.

### 6.1.1 Research Thread #1: Stakeholder patterns of causes

A key characteristic of wicked problems is that stakeholders hold different perspectives on the same problem. One reason for this is the multiple possible causes, along with their interdependencies and the different ways they can be linked and prioritised (APSC, 2007, p. 3). Therefore to gain insight into the wicked problem in this study it was important to identify and make explicit how the various stakeholders made sense of the causes underlying the problem. (Weick, 1995, 2000)

The questions in this thread focus on participants' understanding of what causal factors are required to improve achievement in numeracy for students in low SES schools. The six questions in this thread are:

1. **Causal factors:** what are the understandings of the various stakeholder groups on what is required to improve numeracy in low SES schools?

2. **Causal factor groupings:** how do these understandings relate to the LAND Framework concepts of vision, teaching, community, organisation and outcomes? (Gaffney & Faragher, 2010, p. 13)

3. **Causal linkages:** What linkages do individuals and groups make between different factors and in what directions?

4. **Comparisons:** What are the similarities and differences in understandings within and between each group of stakeholders?

5. **Alignment:** What does alignment mean in this context? What are the points of alignment and or misalignment between these perceptions?

6. **Project impact:** What (if any) changes occur in these perceptions over the life of the project?

### 6.1.2 Research Thread #2: Causal mapping as a process for tackling wicked problems

The second thread of research questions in this study focuses on the collaborative workshop process, using causal maps, and asks the core question 'does this process improve participants' understanding of the 'wickedity' (Bore & Wright, 2009, p. 254) of the problem through the use of boundary objects?' I.e. do participants grow in their shared understanding of the six dimensions of wicked problems identified in

the literature and expressed in the Niche wicked problem framework. The questions for this thread are based on four dialogical learning mechanisms (Akkerman & Bakker, 2011, p. 151)

1. **Identification** (questioning identity and boundaries of different knowledge cultures): Is there evidence of an increase in awareness of their own and other frames of meaning?

2. **Coordination** (processes for dialogue and mediation): Is there evidence of

    a. the process facilitating conversation and grounding? (Kraut, et al., 2002, p. 33)

    b. tacit understandings being made explicit? (Eden & Ackermann, 1992)

3. **Reflection** (coming to realise and explicate differences): Is there evidence of increased participant understanding (as shown in their maps) of

    a. consideration of alternative ideas and associations, also known as 'cognitive diversity'? (Tegarden, et al., 2007)

    b. increased complexity (the number of nodes, where the assumption is that more nodes equals greater complexity)? (Vo, et al., 2005, p. 145)

4. **Transformation** (changes in thinking that lead to changes in practice): Is there evidence of

    a. a recognition of a shared problem space between participants?

    b. the process encouraging an analysis of critical relationships in a system?

    c. the development of 'hybrid' concepts or ideas.

In presenting the findings from the research as answers to these questions, the data for this analysis is based primarily on the causal maps produced by participants both individually and in small groups.

### 6.1.3 Four data sets produced from the causal mapping process

To compare the different patterns of understanding of stakeholder groups, causal mapping has been used, as in previous research, to elicit 'different models' of the problem (Vo, et al., 2005, p. 142). In this study, the causal maps created by participants allow comparisons to be made between the thinking of the different knowledge cultures identified in the methodology chapter.

These maps are evidence of the thinking and collaborative dialogue between participants during the causal mapping sessions held during the workshops. The causal maps also act as boundary objects (Akkerman & Bakker, 2011) by providing a shared visual space (Conklin, 2005; Karsenty, 1999; Langfield-Smith, 1992) for participants to co-create and make explicit their tacit understandings. Copies of the maps are provided in the attached DVD as Appendix #3.

The lists of causes produced by stakeholders were initially created from participant responses to the survey shown in Appendix #1. The relevant survey questions were:

- What are the obstacles to improving numeracy in your school?
- What opportunities are there for improving numeracy in your school?

The responses to these questions were used by this researcher to create *initial causal maps*. During the workshop #3 the participants collaborated in small groups and discussed the causes presented in these *initial maps*. Through their dialogue, each small discussion group produced an expanded and elaborated new map. These new maps were then combined to create a single workshop group *revised map*, to

represent the thinking of the whole group at that particular workshop. Due to the lack of links produced on these maps they could more accurately be described as a revised 'list' of causes. From this collection of revised causes participants were asked to pick the top three most important individual causes.

In a later session in workshop #3 each participant was asked to create an individual causal map by selecting a cause significant to them and creating causal links from this starting point to the outcome of improved numeracy. Maps created in this session conform to the minimum requirements needed to constitute a causal map and can therefore be used to make comparisons.

The final set of data was produced by school cluster groups during the last workshop. Top three causes previously identified were placed on a map as per the LAND framework. The groups were then asked to link the various causes with lines and arrows, including descriptions on the links to show how one cause related to another. They were also asked to show where someone should start so as to interpret the map.

So the four data sets collected are:

1. **Lists of causes:** from the initial and revised group causal maps.

2. **The top three causes:** three causes chosen by each small group as the most important of all the causes on their maps.

3. **Maps:** developed by individuals, each linking a specific cause to improved numeracy.

4. **Causal linking maps:** where links were made between the top three causes chosen by the groups.

### 6.1.4 LAND data used to triangulate and explain causal mapping data

The analysis of the map data is supported by observations taken by LAND project members during the workshops and by other LAND data collected throughout the project. A breakdown of workshops, participants and maps for each jurisdiction is shown in Table #6.1.

***Table 6.1 Causal Mapping Participation Breakdown by Research Groups***

| | South Australia | | Northern Territory | | Western Australia | | | Govt. | Totals |
|---|---|---|---|---|---|---|---|---|---|
| | Adelaide | SA CEO | Remote NT | NT CEO | Remote WA | Perth | WA CEO | DEEWR | |
| Workshop 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | – |
| Workshop 2 | – | ✓ | | – | ✓ | | – | – | – |
| Participants | 16 | 8 | 13 | 3 | 12 | 11 | 10 | 9 | 82 |
| Individual maps | 11 | 7 | 13 | 3 | 12 | 11 | 9 | 8 | 74 |
| Group maps #1 | 5 | 4 | 6 | 1 | 5 | 3 | 4 | 4 | 32 |
| Group Maps #2 | | | 9 | | | 10 | | | 19 |

The details of Table #6.1 demonstrate the large quantity of data to be analysed. The 82 participants generated 125 different causal maps. Complex statistical analysis has been used on causal maps, in previous research, to manage this quantity of data but (as noted in Chapter #5) the maps in this study are a representation of the thinking of individuals or groups, not an objective presentation of actual causes. Therefore, a descriptive and analytic approach will be taken in interpreting this qualitative data rather than a primarily quantitatively statistical one (Yin, 2011, pp. 98-101). Narayanan & Armstrong (2005, p. 8) explain that with this type of "causal map, the nodes are the constructs that the individual feels are important and the arrowed lines show the relations among the constructs". Following the collection of data at the workshops the findings were then aggregated in different ways to support analysis.

### 6.1.5 Three levels of data aggregation

Causes were aggregated into three levels. Specific causes were grouped into subcategories, based on common themes identified by the author, which were then grouped into the main categories of the LAND framework. To facilitate ready interpretation, a distinctive typographic format is used in this study for each level of aggregation with

1. Specific individual causes: shown in green; e.g. Professional learning

2. Causal subcategories: shown in blue, **Bold** & *italic*; e.g. ***Leadership***

3. Main causal categories: based on the LAND framework. Shown in dark red, **Bold** CAPITALS. e.g. **VISION**

The results of the findings look quite different depending on the level of detail at which the data is examined. Therefore an overview of the totals of aggregated causes will be examined before the exploration of specific categories and subcategories.

### 6.1.6 Research Limitation: The lack of causal links in initial surveys

Before discussing the findings in general, one aspect of the nature of the data collected needs to be addressed. School cluster participants provided few causal links in their survey responses. Of the four school clusters, only the Broome school cluster had links in their responses, and then only three. This created a problem because causal maps could not be made from the survey responses. A complete causal map is made up of two main elements: nodes (concepts, causes etc.) and links (lines, with arrows, between nodes) that show some form of relationship, usually causal direction (Narayanan & Armstrong, 2005, p. 2). Thus any analysis of causal maps usually involves assessing the nodes, links and the relationships between them.

In discussion with the LAND project research team we concluded that this would itself be a significant finding and that the workshops would provide an opportunity to develop participants' understanding of causes and causal mapping. At the first workshop session, it became clear that the general idea of cause and causes was a difficult one for the school-based participants to comprehend. Consequently, specific development activities were included in this and in all subsequent workshops.

This lack of linking causes does not align with other research utilizing causal mapping (Vo, et al., 2005). One possible explanation for this is that the results were affected by the survey process. At issue was the question of whether 'text and form' based surveys restrict respondents' thinking to lists of unconnected causes.

Answering this question is beyond the scope of this research, but it is worth noting that the CEO and DEEWR participants responded differently from the school participants. These groups did make causal links in their responses to the same survey questions. The NT CEO had one link from three respondents, SA ten and WA eleven, as well as adding linking words. For example the cause diagnostic tool was linked by the words to support to the cause planning and decisions. There were only five responses from DEEWR to the same survey but there were 17 links from these respondents. Twelve of these links came from one response. This particular respondent formed a textual, causal loop between eight nodes. Some proponents of system dynamics (Vo, et al., 2005, p. 145) consider causal loops the only valid and meaningful form of expressing causes, which would mean that only one respondent from all participants involved in the research was able to respond to the initial question in a meaningful way. This survey response was so startling at the time that I rang the participant and asked permission to conduct an interview and include their responses in the research. The following is a summary of the questions and answers from this phone discussion.

Q: Have you ever had anything to do with causal maps or mapping before?

A: No

Q: Did you have any particular reasons for responding the way you did in the survey?

A: No, I would actually like to revise it because it was a bit wordy but it's just the way I think.

Q: The way you think in general or just how you have to think at work?

A: A bit of both… We need to make connections between things here and that fits with how I think generally. I don't think I am unusual in this. I think you would find most of the people here think in a similar way.

This respondent's causal map is shown in Figure #6.1.

Figure 6.1 Causal loop in response to survey question (DEEWR)

This participant's comments were backed up by participant responses during the DEEWR workshop, in that while the participants still needed to be introduced to the concept of causal mapping, the underlying concepts of cause and effect were well

understood and most of the developmental material was consequently skipped or presented only briefly because it was unnecessary.

Therefore in the data from the survey responses, there is a clear difference in thinking between school-based participants on the one hand and central office (CEO) and government department (DEEWR) personnel on the other. The question as to why this is the case was posed to the DEEWR group, the CEOs and to the school clusters at later workshops. The DEEWR officers explained that the nature of their work included the need to make connections between policy, action and multiple stakeholders and therefore they developed understandings of cause and effect. The personnel from the Catholic Education Offices (CEOs) offered two suggestions to explain the difference:

1. **Time and conformity:** This explanation proposed that busy teachers will comply with demands rather than seek to work through all the underlying issues and connections and then potentially challenge instructions.

2. **The nature of primary school teaching:** The need to present a lot of specific, and often unrelated, bits of information in a simple form is a feature of primary school teaching. Therefore it is possible that thinking in terms of cause and effect, particularly complex causal networks, is not a skill that is frequently practiced.

Both of these reasons attribute the lack of causal linkages in school responses to the fragmented and busy work context within which teachers function. School staff made similar comments to those offered by the personnel from the CEOs. They stressed time as a critical issue, and added a lack of familiarity with cause and effect as a concept, as potential reasons for the differences in responses to the initial survey.

## 6.2 Stakeholder Patterns Of Understanding Of The Causes Of The Wicked Problem

In light of the lack of links, this first section of the analysis of the findings is based on the 'nodes' i.e. the collection of unconnected causes listed by participants in their survey responses and elaborated in the group maps during the workshops. The results from the findings of the collections of causes is presented in this section through a review of a number of different aggregations of data:

- Totals of all the lists of causes from all the groups
- Review of causes under subcategories and LAND categories
- Significant individual subcategories and causes
- The top three causes selected by each stakeholder group
- Individual causal maps

### 6.2.1 Aggregated Totals: Causes (nodes)

At the most general level, answers to the survey questions yielded a total of 299 initial causes. Of these causes, 28 overlapped between different stakeholder groups; the remainder were unique to the individual groups. Therefore, before the collaborative workshops, stakeholder groups presented different patterns of understanding of what is required to tackle the problem of low levels of numeracy achievement among students attending schools in low SES communities.

Responses from the survey were grouped to reflect the LAND framework where possible and *initial causal maps* were created for each stakeholder group. The revised maps from all workshops combined to make a total of 684 individual causes. Of these, 70 overlapped or were duplicated between groups, and the rest were unique. *Therefore, between all stakeholder groups in this research a total of* ***614 unique causes*** *were proposed as necessary to improve numeracy in low socioeconomic status schools.*

This finding is significant in two ways. First, it demonstrates that stakeholders do not necessarily perceive and explain a problem's causal factors in the same way. Second, the large number of disparate causes shows a high degree of complexity and diversity, thus supporting the claim that this is a wicked problem. Complexity here means the number of nodes (causes) listed on the maps, where the assumption is that more nodes equals greater complexity (Vo, et al., 2005, p. 145). Diversity has been defined earlier as referring to the social differences of stakeholders linked to the problem (Head, 2008b, p. 102) and, in relation to the maps, refers to how those differences are expressed as different sets of causes (nodes).

#### *6.2.1.1 Causes (nodes): Aggregated under the LAND framework*

To make sense of the initial 299 individual causes required some form of functional aggregation. For the purpose of this study the LAND framework (shown in Figure #6.2) was used to aggregate individual causes into five major categories. The first and most obvious observation in doing this is that most identified causes readily lent themselves to grouping into categories related to the five elements of this framework.

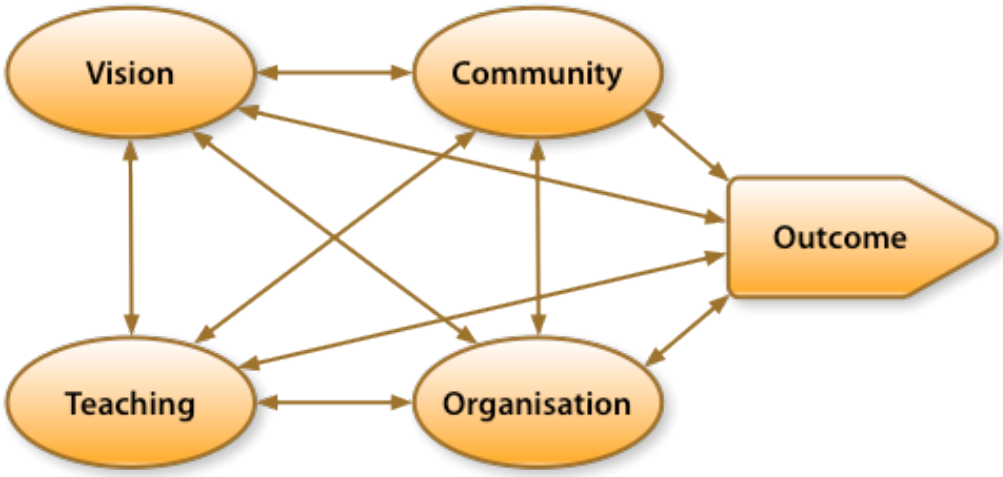


Figure 6.2 The LAND Framework

Almost all of the identified causes can be related to at least one of the LAND elements, thus affording a basis for general comparisons and analysis. These totals are first presented and then followed by an exploration of each of the sets of causes under the categories based on the framework. The number of individual causes in each category are shown in table #6.2 and displayed in the graph shown in Figure#6.3.

***Table 6.2 Individual Causes Grouped Under The LAND Framework***

| Causal Groupings | Original | Revised |
|---|---|---|
| Other | 11 | 37 |
| Evidence | 0 | 47 |
| PD | 19 | 52 |
| Vision | 39 | 84 |
| Organisation | 62 | 100 |
| Teaching | 79 | 167 |
| Community | 89 | 197 |
| | 299 | 684 |

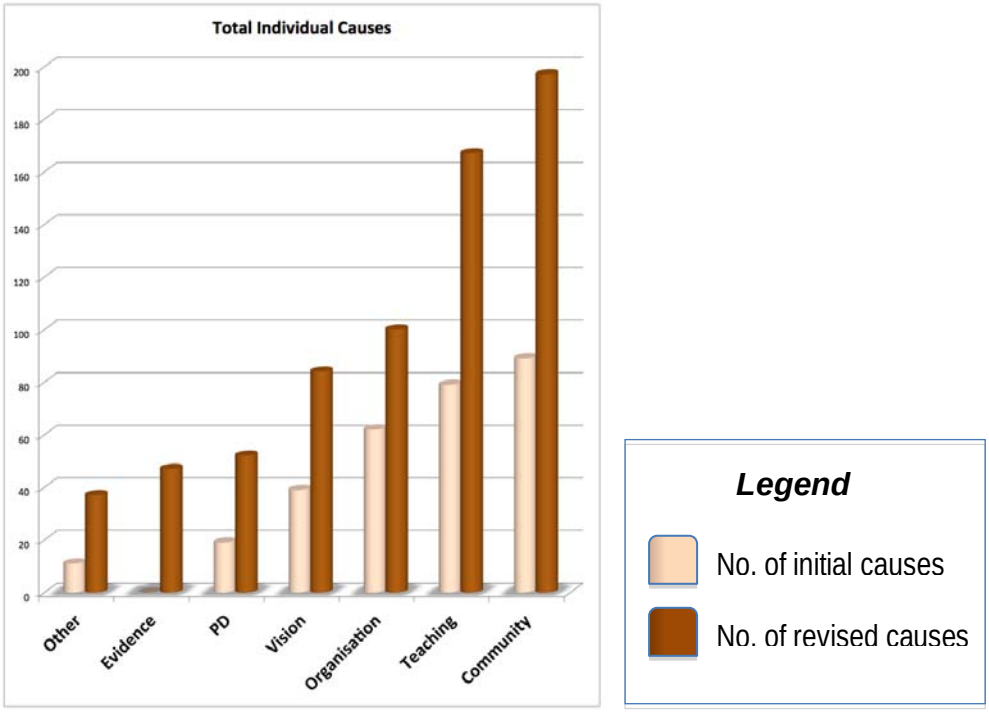


**Figure 6.3 Individual Causes grouped under LAND framework**

In response to the question about **Causal factor groupings:** how do these understandings relate to the LAND Framework concepts of vision, teaching, community, organisation and outcomes?, it was found that causal factors were able to be mapped onto the LAND framework. It is therefore reasonable to conclude that a general alignment exists between the aggregated thinking of participants and the research underlying the LAND framework. The relationship between causal factors and the LAND framework retained a similar profile from the initial causes (developed from the pre-workshop surveys) and the revised causes (identified through the causal mapping sessions during the workshops). All the revised groupings also showed a substantial increase in the number of causes participants identified, in many cases more than doubling the original number. This is consistent with expectations from the role of the maps acting as boundary objects (this is further explained in section #6.3.4).

Another observation is that all the LAND categories include significant numbers of causes but range from around 40 causes for the category **OTHER** to almost 200 in the case of the revised **COMMUNITY** grouping. So, the total responses from participants can be seen to align with the LAND framework at this very high level of aggregation and if consideration were given to only these general numbers, it could be concluded that participants considered **COMMUNITY** as most important followed by **TEACHING**, **ORGANIZATION** and then **VISION**. However, in Section #6.2.4 the findings of participant choices for their top three causal factors are reviewed. This review demonstrates that the number of causes listed in a category does not necessarily give an indication of its importance.

### *6.2.1.2 The anomaly of the EVIDENCE category*

One significant difference on the overall numbers is that there were no causes listed by participants in the initial **EVIDENCE** category but some were placed on the maps by the project team prior to the workshop in order to promote discussion. Consequently, all causes listed under **EVIDENCE** for the revised maps are new and additional to those causes provided by participants in the pre-workshop surveys. **EVIDENCE** is associated with the LAND category of **OUTCOMES** and is used as its broad equivalent throughout this analysis.

This high level aggregation provides limited insights into the understandings of the various stakeholders and the next step therefore is to compare the contributions from the various stakeholder groups.

### *6.2.1.3 Comparison of total revised causes by stakeholder groups*

A comparative breakdown of the total revised stakeholder contributions to the list of causes of numeracy improvement is presented in Figure #6.4. The data has been represented as a line graph grouped under the categories corresponding to the LAND framework as presented in Table #6.2. The coloured lines on the graph relate to the three main stakeholder knowledge cultures from the participant groups: schools, education officers and government employees.

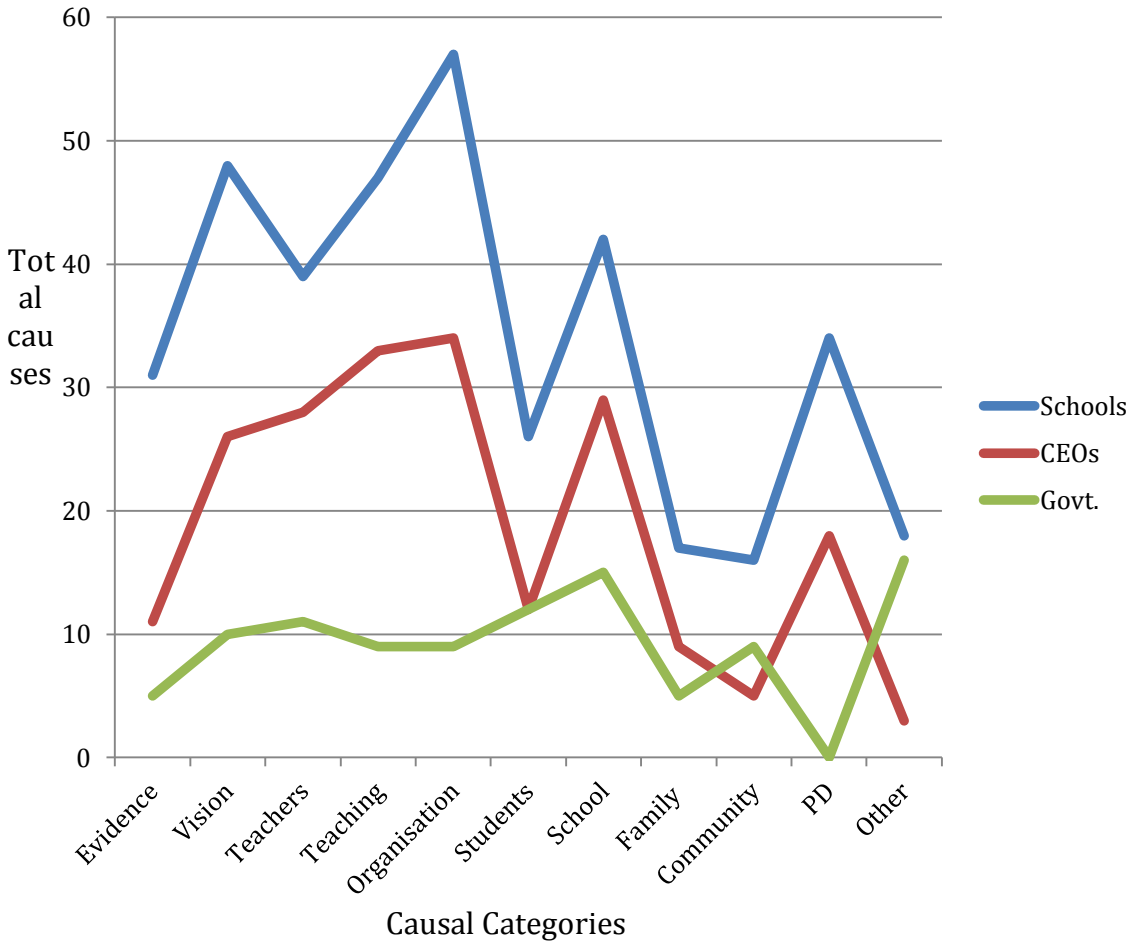


Figure 6.4 Revised Stakeholder Totals in Causal groupings

From Figure #6.4, a number of observations and comparisons can be made about stakeholder contributions to the list of causes and their relationship to the LAND framework. First, in terms of the stakeholder proportions for each category, the profiles of the school and CEOs lines, (blue and red) in the graph show a degree of consistency. This would seem to imply a similar outlook on the general make up of the problem.

The responses from school clusters make up half to two thirds of the total responses. Next in size are the CEO responses, with the smallest part provided by the government respondents. This broadly corresponds to the numbers of participants in each group, (see Table #6.1) showing similar numbers of causes in each category per person for each group. So it is possible to speculate that the number of causes

identified for a problem will be similar for all participants given the same time and conditions in a mapping session.

Despite the general similarity of profiles, closer examination of the graph in Figure #6.4 reveals some significant differences between the three knowledge cultures. The government personnel from DEEWR listed a large number of causes under **COMMUNITY** but none in the **PD** category, to which the other two knowledge cultures contributed multiple causes. In addition, the **OTHER** category was the largest for DEEWR but one of the lowest for both schools and CEOs. These differences are explained in the analysis of the individual categories below.

At this highest level of aggregation the responses from participants appear to align with the research on improving numeracy, and there also seems to be a high degree of similarity between the different stakeholder groups. This can give the impression of homogeneity of thinking across the groups in the study. However, under this general agreement lay some widely divergent perspectives that only emerge from a closer look at the more detailed findings in the following sections.

### 6.2.2 Categories & subcategories: Causes (Nodes)

This section of the findings looks at the collections of revised causes for each of the categories (the groupings of causes under the LAND framework) and the subcategories associated with them. Descriptions of the similarities and differences between participants groups are presented as well as an overview of the distinctiveness of each knowledge culture.

### *6.2.2.1 Similarities and differences overview*

Comparing the contribution of causes from each participant knowledge culture reveals a pattern of similarities and differences. The numbers of causes identified per participant appears to be relatively constant across all groups. The focus of the issues that relate to the causes listed are generally similar between the school clusters and the CEOs but differ from the interests of the government group. Patterns of difference are also found in the range of views presented in relation to the generality, immediacy and context of the terms used. Differences between groups in the meanings attributed to similar terms are also discernable. How all these patterns were expressed for each category of the LAND framework will now be discussed in detail.

#### The Evidence Category

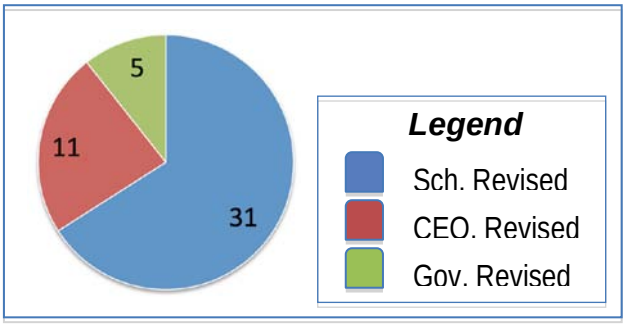


Figure 6.5 Revised Stakeholder total causes for Evidence

The **EVIDENCE** category is probably the most straightforward and it stands out as the only part of the causal maps that was introduced to the participants during the workshop with causes already added. This was done because the project leaders wanted the participants to consider the causal factors relating to evidence along with causes in the other part of the framework.

The pie chart in Figure#6.6 shows that for **EVIDENCE** we have a proportional breakdown such that schools identified approximately two-thirds of the 47 listed causes, the CEOs two-thirds of the remainder, and DEEWR the final 5. These

proportions roughly correspond to the number of respondents in each group, showing no significant difference between the groups numerically.

Most respondents did not try to group their causes. Instead, they provided a list, usually of specific examples of evidence. In contrast one member of the Adelaide schools cluster began the discussion with his group by asking what the larger groupings within **EVIDENCE** should be. In response, they divided the **EVIDENCE** bubble into ***qualitative***, ***quantitative*** and ***mixed*** forms of data. I have adopted these subcategory headings as useful ways to group the causes and added a final one, ***process***. These four terms draw together the variety of meanings of causes in this category.

Looking at the specific causes listed by each group, the numerical similarities give way to important differences in focus and level of specificity. The contributions from the government personnel participants were 'high-level' and general. High level is used here to denote the type of language used in executive summaries (Delbridge, 2005, p. 896). They included two of the five causes on ***process***, being diagnostics and best practice, as well as participation in extracurricular activity. This 'high-level' generality from DEEWR participants is a theme that appears in all the categories.

In contrast school cluster participants tended to provide specific, classroom-focused causes, such as scores on easy-mark, standardised tests and classroom displays. The causes listed by CEO participants were similar to the government in their generality but closer to the schools in their focus. They included student attitude, annotated work samples, psychology reports, health reports and the general reference to other data collection. There was also diversity in the topics of the causes identified. Individual causes listed in the **EVIDENCE** category generally do not overlap except for three: photographs (three schools), DVDs and videos (two schools), and journaling (two schools).

The ***quantitative*** data include fairly standard forms of school assessment such as classroom tests, student assignments, homework and maths assessment folders. Scores on NAPLAN were also included here. ***Qualitative*** data included the overlapping causes of photographs, DVDs and journaling, as well as student reflections, teacher observations and

anecdotal records, and activities involving interactions and counseling by the teacher. Causes listed under ***mixed*** include surveys, diagnostic tests, classroom displays and artefacts and annotated work samples. ***Process*** causes included the collection and tracking of data, student diagnostics and a general comment on best practice evidence-based.

## Professional Development (PD)

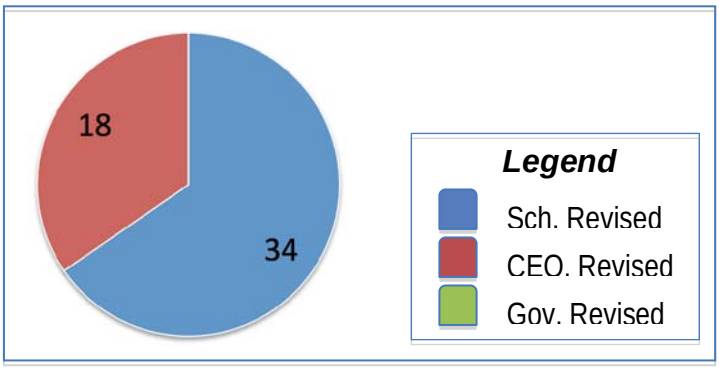


Figure 6.6 Revised Stakeholder total causes for Professional Development (PD)

| *Table 6.3.Professional Development* | |
|---|---|
| ***PD targeted for*** | 6 |
| ***PD structures*** | 24 |
| ***Research*** | 2 |
| ***Maths/numeracy PD*** | 8 |
| ***PD topics*** | 4 |

The category of **PROFESSIONAL DEVELOPMENT (PD)** was placed on the causal maps in a similar position by most participant groups, between the LAND categories of **VISION**, **TEACHING** and **COMMUNITY**. The patterns emerging in this category are similar to those in the **EVIDENCE** category.

**PD** drew a total of 52 causes subsequently grouped into five subcategories (shown in Table #6.3). The groups that contributed to this category listed an almost equal number of causes per person. DEEWR and the NT CEO placed nothing in this category but both of these groups did provide a couple of PD related causes under **TEACHING**. There was almost no overlap between groups, with only eight

instances of duplication between all the groups and in every case only two groups listed the same cause.

About half (24) of the causes listed related to the structure and timing of PD, including the length (short, day), frequency (regular) and type of activity: staff meetings, shoulder to shoulder release, workshops, class visits, learning communities, peer learning, mentoring and visiting experts, reading groups and PD situated at remote sites.

Participants were also concerned that PD needed to be targeted for different groups and should include early career and new staff, building leadership and updating staff. Topics also ranged from maths (6) to interpersonal skills and addressing individual needs. Evidence was also listed as relating to action research as a form of PD.

So what patterns can be discerned from these results? That PD was created as its own category shows the importance attached to it by the school based stakeholders and most of the CEOs (though not apparently by the DEEWR participants). The focus on alternative structures for PD demonstrates a sophisticated approach to how different types of development can be targeted to meet specific needs for teachers in particular school settings.

In contrast, the personnel from DEEWR had a different focus in general from the other two groups. PD was only mentioned under **TEACHING**, with none of the specificity of the majority of participants. These observations provide an insight into the different areas of interest for the different groups. The teachers, principals and CEO personnel are explicit in seeing the development of teachers as essential for improving numeracy in their schools. In contrast, while the federal government participants note the need for quality teachers, they present no explicit detailed ideas on how those teachers are developed.

### Similarities and differences in the four main LAND categories

The four main LAND categories of **VISION**, **TEACHING**, **COMMUNITY** and **ORGANIZATION** include multiple subcategories of wide ranging causes with few overlaps, as shown in Table #6.4. Equivalent subcategories are placed in the same rows where possible.

***Table 6.4 Subcategories of causes listed under LAND Framework***

| VISION | TEACHING | COMMUNITY | ORGANISATION |
|---|---|---|---|
| Leadership | Strategies | Leadership / Vision | |
| Teachers | | Teaching | |
| Community | | Links with community | |
| Organisation | | Planning | Planning |
| Evidence/outcomes | | | |
| | PD | | |
| Focus | | | |
| Improvement | Programs | Improvement | Projects |
| Improvement culture | | | |
| | Tools, use of resources | Resources | Resources / classrooms |
| | | | Resources / funding |
| Change | | Processes & change | Processes & change |
| | | Structure | |
| | Lessons | Interaction with classroom | Lessons & classrooms |
| | Assessment | | |
| | ICT | | |
| Interactions/Relationships | Relationships & Teams | Staff / people | Collaboration / networks |
| | | Interaction with school | |
| | | Home school links | |
| Attitude/mindset | | Corporate culture | Communication |
| | Curriculum | | Curriculum |
| | Pedagogy | | |
| | Whole school pedagogy | | |
| Numeracy | | Community numeracy | |
| Local | | | |
| Capacity | Teacher skills etc | | |
| | | System | |
| | | | Time / Rhythms |
| Policy | | | Support |
| | | | Staffing |
| | | | Timetable |
| | | Student/family background | |
| | | Home environment | |
| | | Community environment | |
| | Other | | Other |

From this table it can be seen that different participants placed similar causes under different categories. This observation relates specifically to the ambiguity dimension of the Niche Wicked problem framework. Ambiguity was evident between

stakeholders not just in the different meanings they attributed to words but also in the ways they thought about causes. For the same causes, differences appear in categories with which they are associated, the level of grouping and what they are linked to. This shows that people are structuring their thinking differently even while using similar terms.

In most cases the meaning of a specific cause was contextually related to the category in which it appeared. For example, the large number of causes that relate to relationships and interactions appear in different forms in three of the four categories. In **VISION**, the individual causes are more high level and general, such as co-responsibility and engaging teams in a meaningful way, while under **COMMUNITY** there is a broader range of more specific causes relating to relationships within the school, and between the school, home and the wider community. Causes here include parents feeling comfortable and welcome as well as confident to liaise with the school and accessible communication. Similar causes in **ORGANISATION** focused on collaboration and networks.

Observations on each of these four LAND categories will now be addressed in turn.

### *6.2.2.2 The VISION category (knowledge culture dominance)*

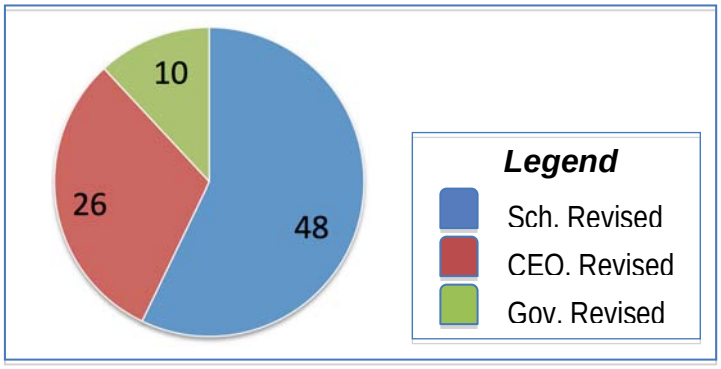


**Figure 6.7 Revised Stakeholder total causes for Vision**

The **VISION** category was also given the label **THINKING ABOUT IMPROVEMENT**, and renamed by some of the CEO groups as **LEADERSHIP**. The **VISION** category has some similar characteristics to the other three categories of (**TEACHING**, **COMMUNITY** and **ORGANISATION**). Although it is the smallest of the four categories it still contains multiple causes. There are 84 individual causes identified, which have been grouped into 15 subcategories. The proportions are also similar to the other three main categories, with school clusters listing 48 causes, CEOs 26 and the government 10.

This category is characterised by the dominance in each subcategory by either school clusters or CEOs and DEEWR. This is observable throughout the category except in the subcategory ***attitude***, where both school clusters and CEOs are represented but not DEEWR. (***Attitude*** includes causes such as mental models, high expectations, reflection, increase awareness and shared vision.)

***Leadership:*** (DEEWR & CEO dominance)

Leadership was a key theme of the LAND project and could therefore be expected to include a large number of causes listed by the school clusters, since they received professional development on this theme. Instead, the ***leadership*** subcategory was dominated by the CEOs and DEEWR. The ***leadership*** subcategory also contains one of the few causes that were identified by 4 different groups, namely effective-strong leadership. All of the CEOs and DEEWR listed this cause, but no school clusters did. In contrast, the only two causes listed by any school clusters in this subcategory of leadership were empowered teachers as leaders and dispersed leadership, both coming from the Northern Territory cluster.

Leadership appears in other parts of group maps including a whole subsection in the **SCHOOL** category, with similar individual causes as those listed under **VISION,** and again dominated by the CEOs and DEEWR. There is also a CEO listing in **PD** on

building leadership capability, and a DEEWR one in **ORGANISATION** under ***staffing*** titled quality leadership, recruitment and retention.

So, even though this concept was explicitly raised by the LAND project team, it was not seen as relevant by school cluster participants. This raises questions for further research that is beyond the bounds of this study:

- Why does leadership not have a more central place in the thinking of school level participants on how to improve numeracy?
- What is the nature of 'leadership' as it is conceptualised by the different knowledge cultures involved in education?

***Focus:*** (School Cluster Dominance)

In the ***focus*** subcategory the opposite participant profile is found to that in ***leadership***. Only school clusters are represented here with each of the following causes listed three times: shifting focus from literacy to numeracy and emphasise numeracy. One possible reason for this finding could be that schools are more inclined to shift focus as they face the specific hands on issues related to the problem, while government personnel, being more removed from the actual problem, keep to a more general approach to the problem's different parts. This can be seen as a characteristic of the context loop in the Niche framework. Although each group is working on the same problem their contexts differ significantly. Government employees often only deal with a specific project or issue at a time, while primary school teachers and principals have to juggle the multiple projects occurring within a school.

### *6.2.2.3 The ORGANISATION category (practicality & specificity)*

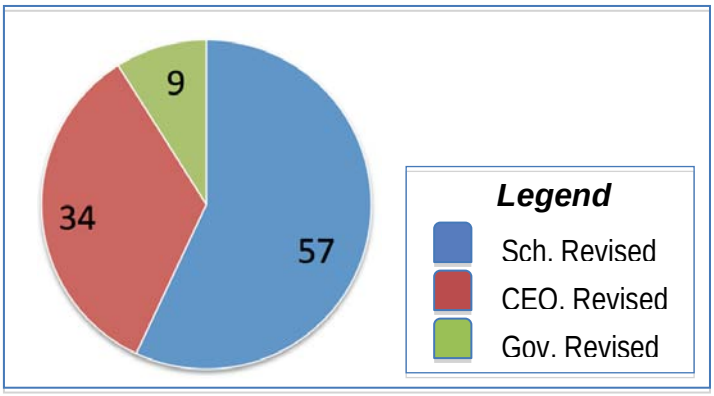


**Figure 6.8 Revised Stakeholder total causes for Organisation**

Practicality and specificity appear to be the hallmarks of this category. In line with this category's name, virtually all the causes listed here relate to how a school is organised and run. Once again schools dominate with 57 causes, followed by the CEOs 34 and finally DEEWR, which listed only 9 causes in this category.

As with other categories, DEEWR responses were usually high level, often no more than a one or two word heading such as curriculum, communication, shared vision, improvement culture, quality staffing and leadership and resourcing. These examples also all seem to be somewhat misplaced as most would appear to fit more naturally under other categories.

A few groups had their own areas of interest, with specific discussions generating a number of causes in a particular subcategory. The Adelaide cluster provided more than half the causes relating to ***collaboration and networks***, in contrast with the other school clusters who each listed only one or two and, in the case of NT, none. At the CEO level WA included six causes in this subcategory, while SA and NT listed only two each. DEEWR did not include any causes relating to ***collaboration / networks***.

This profile of contributions aligns with observations of each of the groups. The dispersed geography and remoteness of the NT schools meant that there were fewer

opportunities for collaboration, at least in a face to face sense. They therefore expressed their need to 'go it alone'. On the other hand both the SA schools and the WA CEO saw collaboration as a key way of working. Causes listed in ***collaboration*** ranged from teachers collaborating between classes, to whole school sharing and discussion, then more broadly to interactions between schools and finally system wide partnerships.

The ***planning*** subcategory was represented by the SA and NT teachers and the WA CEO and included causes from the more general planning and decisions down to the more specific year level planning and a regular planning time. There were also a few related causes grouped under ***time***, including time for planning, rhythms for when to teach maths and having a dedicated time for teaching numeracy. Timetabling issues should also be noted here with entries from NT schools and CEO, and WA schools and CEO.

The four subcategories of ***support***, ***staffing***, ***resources*** and ***classroom resources***, contained loosely related causes. Resourcing as a general concept was proposed by the CEOs and DEEWR, while specific examples such as funding for projects and numeracy staff were proposed by the school clusters. ***Classroom resources*** were mainly listed by the schools and included specific references to class resource boxes, textbooks for all years and centrally located class resources.

The ***Staffing*** subcategory followed a similar approach with DEEWR including the general need for quality staff and leadership recruitment and retention, while schools and CEOs listed specific numeracy teachers and ATA positions.

The causes from the **ORGANISATION** category were strongly represented in the project work undertaken by the schools and presented in their final workshops. This was a result of the practical choices made by school clusters in how they changed various organisational elements in their school and classroom processes to improve the effective delivery of numeracy. Thus this category was dominated by the specific and concrete factors schools have control over when trying to address the problem

of low numeracy achievement. In contrast, the causes listed by DEEWR in this category were typically high level and could be perceived as more 'conceptual' and distant from the day to day practice of schooling.

### *6.2.2.4 The TEACHING & TEACHERS category (diversity)*

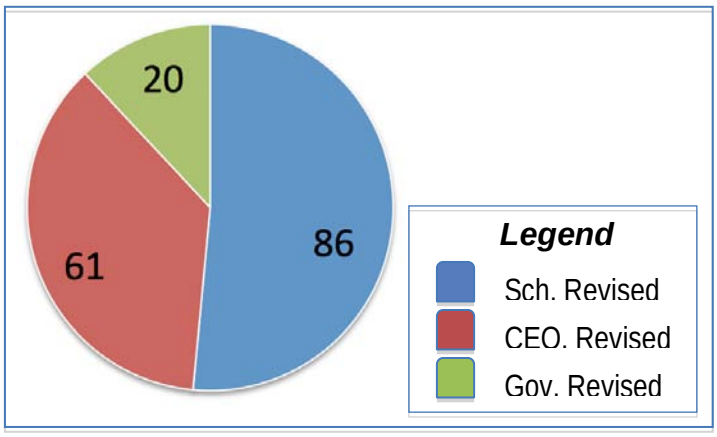


**Figure 6.9 Revised Stakeholder total causes for Teaching & Teachers**

This, is the second largest of the LAND categories and is also one of the most diverse, with multiple causes listed under subcategories related to the two categories of **TEACHING** and **TEACHERS**. Despite the great number of causes, very few of them shared similar meanings.

Causal subcategories listed in **TEACHERS** included ***knowledge, attributes, attitude*** and ***PD requirements*** of individual numeracy teachers, with a number of causes overlapping between schools and CEOs but not DEEWR. Once again the federal government participants listed causes in similar categories but often with a different emphasis or approach. For example, teaching resources, recruitment and collaboration were listed here by DEEWR but no-one else. The causes provided by them also tended to be more general or 'big picture'; where schools might list specific attitudes and skills required by teachers, the DEEWR map just had attitude and skills.

A number of groups included ***PD*** as a subcategory within **TEACHERS AND TEACHING**, while others made this a separate category as discussed in Section #6.2.2.1.

Of the twelve causes listed under ***relationships*** and ***teams*** only shared knowledge appeared in both. The causes ranged from the individual-focused having someone to talk to through to the school-focused shared responsibility and utilizing all staff. Contributions were made from every participant knowledge culture, with more general causes listed by CEOs and DEEWR. Some CEOs also placed ***teacher skills*** under the **TEACHING** category, with similar types of causes listed.

Other types of teacher skills were listed as causes under the subcategories of ***pedagogy*** and ***whole school pedagogy***. The other causes listed in these two were general, utilising phrases that included the term 'pedagogy' such as productive pedagogy. Six of the 11 causes listed came from the Perth schools cluster.

As previously observed, some subcategories in this category could also be placed in other categories on the LAND framework, with ***strategies*** fitting in the **VISION** space, ***assessment*** matching **EVIDENCE** and ***PD*** making an appearance. The differences are in detail and focus. Virtually all the ***strategies*** listed relate to specific classroom lesson approaches rather than school or policy, while ***Assessment*** includes more generalised causes than those listed under **EVIDENCE**.

Finally, a number of individual causes were grouped under ***other***. Most were 'big picture' and generalized, with half the contribution coming from DEEWR and the rest from the CEOs. Causes listed here include expectations of student ability, de-privatisation of the classroom and whole school/system framework.

That stakeholders involved in improving numeracy consider teachers and teaching to be fundamental is evidenced by all the participant groups contributing causes to these categories. However, there was little overlap between the individual causes

listed by each group. This provides a good example of diversity as it relates to wicked problems. Each knowledge culture perceives concepts through the filters of their own interests, priorities and epistemologies (V. Brown, 2008). Therefore even simple terms such as teaching can be interpreted in widely divergent ways by the different stakeholder groups involved in the problem.

### *6.2.2.5 The COMMUNITY category (complexity & ambiguity)*

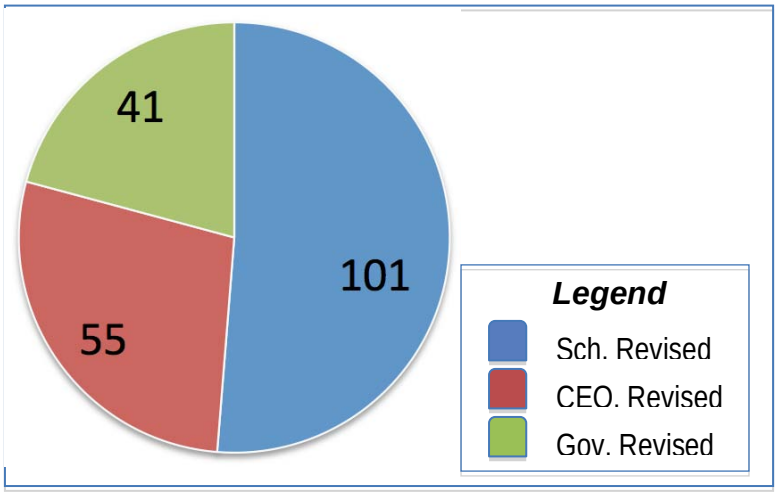


**Figure 6.10 Revised Stakeholder total causes for Community**

This category includes the major subcategories of ***local community***, ***school, students*** and ***family/home***. It is both the most complex category and the one that changed most between the original maps and the revised versions. Both ***school*** and ***students*** doubled in size, while ***family*** went from 7 causes to 31, and ***local community*** from 5 to 29. The initial lack of causes under these latter two were quite obvious visually when participants first discussed their maps, with a number of people expressing surprise that no-one had listed anything under these subcategories. This supports the view that collaborative mapping activities provide a way of checking that multiple dimensions of a problem are identified and addressed .

A jump from almost no causes to the filling out of a whole subcategory can be seen in the ***school-home*** and ***school-community*** relationships subcategories. These two groups appear interchangeable but are listed separately because participants placed them in different larger bubbles on their maps. DEEWR listed only two causes in these groups: community engagement and links to remoteness.

Ambiguity, as well as complexity, were observable in the contributions to this category. The revised maps of these subcategories included groups of causes that could be interchangeable, including ***background***, ***environment*** and ***relationship with the school***. This demonstrates the potential for ambiguity as each group utilises terms that reflect its own cultural usage. Although similar in general concept the terms' meanings differ in emphasis and nuance.

The contributions from the different groups have a similar profile as the **TEACHING AND TEACHERS** category in the total numbers of causes listed but are distributed quite differently at the more detailed granularity of the subcategories. For example, all groups contributed to ***family*** except SA schools and SA CEO, while under ***local community*** the SA schools accounted for over a third of the causes listed.

***Family*** also included the subcategory ***home environment*** which had 11 causes, with contributions from DEEWR, WA CEO and all the schools except SA. It included such things as parental engagement, expectations and enriching environment. The equivalent subcategory in community included more general causes such as environment, local empowerment and community needs. Causes relating to the background included cultural, education and work experience.

Participants grouped multiple causes into three further subcategories under the general subcategory of ***students***. These were ***student attributes***, ***school*** and ***interaction with school/class***. ***Student attributes*** attracted 19 causes, providing a comprehensive and wide range of concepts including knowledge, skills, abilities,

differences, learning styles and needs. Causes listed under the ***school*** subcategory in ***students*** came mainly from DEEWR and the SA CEO, and had a student learning focus. They included empowered kids, sense of belonging, support and care for students, and initial school success.

***Interaction with school/class*** was of a similar size to ***student attributes*** with 20 causes listed. Causes here ranged from student-related issues such as attendance, engagement, learning needs and cognition, through to the more general concepts of classes being value driven and providing access to resources and participation.

The subcategories grouped under the major subcategory ***school,*** in the category **COMMUNITY**, function almost as a microcosm of the LAND framework. There was a similar number of contributions from every participant group except the NT CEO (who only listed 2 causes). The causes listed in each of these subcategories, within the **COMMUNITY** category, align with their equivalents in the other LAND categories but are focused on and around the school.

There were also a few subcategories that were distinct from the LAND categories, including ***structure & processes*** and ***system***. The first of these included causes related to size, of both classes and school, and the use of space and practices across the whole school. ***System*** will be dealt with separately in Section #6.2.2.7.

In summary, this category demonstrated the value of the causal mapping process in encouraging participants to consider a wider range of causes than those that initially come to mind. The differences in detail also highlighted aspects of the ambiguity and complexity dimensions from the Niche framework.

### *6.2.2.6 The OTHER category (difference)*

| *Table 6.5. Other* | |
|---|---|
| ***System*** | 2 |
| ***LAND*** | 12 |
| ***Future Focus*** | 5 |
| ***Collaborative Professional Learning*** | 1 |
| ***Projects*** | 4 |
| ***Government*** | 12 |
| ***Power*** | 2 |

The **OTHER** category gathered together subcategories that did not fit under the LAND framework. Consequently it became the category of difference. Almost all of the subcategories (listed in Table #6.5) were represented by particular contextual interests of one of the knowledge cultures represented in the stakeholder groups. The emergence of this category shows the limitation of any model that attempts to encompass the complexities of wicked problems. No model can be guaranteed to capture all the potential permutations of stakeholder thinking.

The majority of causes listed in the category **OTHER** come from two school cluster groups (Adelaide and Perth), and DEEWR. Each cause was only listed once, and (as Table #6.5 shows) the numbers were also small. It is possible to move most of these causes into one of the other categories but the participants deliberately chose to place these causes apart from the other categories so I have honored those choices. A selection of the **OTHER** subcategories are now briefly explored.

#### ***LAND***

The SA school cluster built 12 causes under a LAND heading. Other groups, including DEEWR, discussed the significance of the LAND project for improving numeracy but no-one else listed it as a separate category. A few schools included LAND under ***maths*** and ***numeracy PD*** and one school placed it under ***projects***. Why only one group would make this identification is not clear but it does highlight again the

diversity of thinking even when all the groups had the same exposure to the LAND project.

### *Future Focus*

The WA schools were the last of the school level groups to have their workshop, which occurred about six months after the first. This meant that the project as whole was a bit further along and consequently there was more of a focus on what actions they might take after the project finished. This led to a number of related discussions about the future and is reflected in the listing of this as a subcategory only by these participants.

The causes listed in this subcategory had future importance but were not in the scope of work for schools at the time. They include scope and sequence of numeracy, parent education, the use of new ICT such as iPods, and two numeracy topics: addition and counting. All of these causes were specific and action-focused with the related discussion revolving around how these things would be operationalised. On the map they were placed near the **OUTCOMES**/**EVIDENCE** bubble.

### *Projects*

The ***projects*** subcategory was similar to ***future focus*** in that it recognised the importance of previous projects but also looked forward to the need for similar support to sustain the improvement of numeracy.

### *Government*

One of the unique aspects of the DEEWR maps was the creation of a ***government*** bubble/category, which was placed as a subset of a larger **SYSTEM** bubble. All the individual causes listed in this category appear related to the work of federal public

servants. This subgroup provides an example of a contextual understanding and priority based around the knowledge culture of one particular stakeholder group.

### *Power*

The discussions in the SA CEO kept moving back along causal chains in an attempt to find the most significant, underlying and foundational causes. This is reflected in this small but critical subcategory of ***power***. It only includes two things: who makes the decisions and construction and distribution of power, but it sums up some very deep and thoughtful dialogue. This is a prime example of the limitations of a statistical analysis of causal maps. These two causes are profound and different in nature but their significance can only be gauged through observation of the dialogue between group members, not by their placement on the artefact of the map.

## *6.2.2.7 Distinctiveness of each knowledge culture*

From the findings described above it is possible to discern distinctive features for each of the knowledge cultures represented in the participant groups. The government personnel provided high level, theoretical, general causes focused on systemic issues. In contrast the school cluster contributions were primarily concrete, specific and focused on school level issues. The CEO participant groups ranged from the big picture and systemic thinking of the WA group through to the quite local focus of the NT CEO.

### DEEWR

The DEEWR responses created a distinctive map which will now be looked at in some detail. The DEEWR revised map, shown as Map 6.x, was unique in a number of ways including

- Creation of a **GOVERNMENT** bubble/category
- Creation of a 'mega' bubble called **SYSTEM**
- Multiple causal loops
- Additional page required to include all the **COMMUNITY** causes

Drawing these elements together provides an insight into this particular knowledge culture. These stakeholders were the most conversant and at ease with the concept of causes and causality but were also the least specific in their terminology and description of the causes required to improve numeracy achievement. Their dialogue and map can be described as very 'big picture' with a government project system centre.

This is not surprising given the concerns and expertise of the participants in this group. For example, during their workshop participants described their experiences in designing and being responsible for numerous projects similar to the LAND project, as well as developing policy in the area. So, although these DEEWR personnel have responsibility for the projects that the other stakeholder groups in this study are running, there is significant misalignment in their thinking on what is required to improve numeracy achievement. This issue of alignment will be addressed in section 6.2.2.7.

Figure 6.11 DEEWR Revised Causes

### Catholic Education Offices (CEOs)

The CEO maps range in their level of sophistication, focus and specificity. The WA and SA groups are similar, while the NT map has characteristics more inline with the school cluster groups.

The WA and SA CEO group causal maps include causal links, which is a feature of the DEEWR maps but not of the school clusters. The WA map is the most sophisticated of the CEOs with links that relate primarily to planning, diagnostic tools and date. The links contain causal comments such as 'driving' and 'to support', that present causal direction and cause and effect between the nodes on the map. There are also a few links between various support types of causes. The SA map also contains links but lack associated comments. The links are connected to causes that relate to the national curriculum, NAPLAN, PD and the reviewing of programs and pedagogy.

Therefore these two CEOs are similar to the DEEWR participants in perceiving that causes have effects that lead onto other causes making a causal chain. However, unlike the DEEWR map, these linkages did not lead to causal loops where the final causes feed back into the causal system. The differences in focus are also interesting. This knowledge culture is responsible for the oversight of PD for schools and the application of national policy. Therefore it is not surprising that both groups identified administrative and support type causes in their causal chains, the differences reflecting the immediate priorities of each group. WA had spent a number of years developing systems and putting review processes in place, therefore they were keen to now develop the general planning and diagnostic process in their schools. The SA CEO was undergoing changes in personnel and structure and was intent on gaining a picture of the current system through reviews. The immediacy of different concerns is not a statement on how each group views the problem as a whole but on what issues they are currently dealing with in their own situation; in other words, their appreciation of their context has a noticeable impact on how they perceive causes and effects.

The appearance of the NT CEO map has more in common with the school cluster maps. There is only one link (between the subcategories of ***teaching*** and ***students***), and the causes identified focused on school level issues. The reasons for the differences in this group's map are dealt with in section #6.3.3.1.

### The Northern Territory participants: (Local community knowledge culture)

The NT school cluster and CEO consistently presented specific causes that differed from all other groups when discussing indigenous remote schooling. Causes relating to staff quality, turnover and experience appear in various forms in a number of categories. These issues were at the forefront of the discussions in the workshops for these stakeholders. In comparison, the Broome cluster (with a similar high proportion of indigenous students to the NT schools) and WA CEO aligned with the rest of the groups and did not focus on these causes.

This unique perception of self was discussed with quite a few participants from each of the groups, including the NT people themselves. The reasons provided for this self-perception included

- The territory takes a special sort of person due to its unique environment
- The WA indigenous schools are linked to the urban schools through the same CEO personnel, whereas the NT schools are isolated from other school and CEO groups.
- The NT CEO had less time and history to develop its systems and teachers.

Whether these or other reasons can explain this distinctive self-perception would be a fruitful focus for future research.

### School clusters

In spite of the unique contexts of each of the school clusters there was a high degree of similarity between schools. The only group who considered themselves 'different' was the NT school cluster as mentioned in the previous section, (and other school clusters did not 'see' these 'differences'.) This sense of similarity was commented on in the presentations given by schools at the final workshops. Multiple groups identified specific local issues but then linked them back to similar principles or categories of causes. A good example was the various ways that schools physically organized their resources. The individual characteristics of each of the schools differed but the principles of streamlining and improving access to resources were similar.

Conceptualising the issues related to their specific contexts to find the common underlying principles was a common theme of the workshops. This was explained by participants as a consequence of being brought together in a supportive, collaborative environment with a common goal of trying to improve numeracy achievement in their schools. The LAND project team were pleased that this also seemed to reflect the various frameworks and PD concepts that had been provided to participants throughout the project. This outcome aligns with the literature as it is summarized by the Niche framework. Drawing out the multiple dimensions of the problem in a collaborative manner encouraged a greater shared understanding.

This completes the review of the distinctive contributions to the findings from each of the knowledge cultures represented in the participant groups. The next subsection considers a few significant causes which emerged from the findings that do not neatly fit in any of the major categories listed so far.

### *6.2.2.8 Other significant causes and groupings*

Observing the development of participant maps and the associated discussions, a few causes and terms stand out as significant in their own right. Some subcategories were created by small groups through the use of 'bubbles' on their maps. Some individual causes stand out; e.g. student attendance was raised by most groups but in unexpected ways. The term 'system' is also worth exploring as it provides a clear example of the issue of ambiguity as it relates to tackling wicked problems.

#### Creating subcategories through 'bubbles' on maps

Some subcategories are a reflection of the creation of a particular bubble on a group's map. The best example of this is ***improvement culture***, where the six causes listed all came from the Broome school cluster. Similarly, five of the eight causes listed under ***change*** all came from the Adelaide school cluster. This can be seen as a natural artefact of the nature of the dialogue during the mapping process. In their small groups participants were observed to discuss a particular area of the map and this would generate ideas with a theme common to that part of the map; therefore a bubble would be drawn around this collection making a new subcategory. These discussions frequently reflected the specific interests and context of the people in that group. The small groups reported back to the group as a whole before engaging on the next task, this often resulting in a disbursement of ideas as other small groups picked up on what had been presented.

#### Student attendance: (Foundational causes for Learning)

Student attendance appears in three different places on the maps, all in the **COMMUNITY** category: ***students*** (schools and DEEWR), ***family*** (WA CEO) and ***community*** (SA Schools), but with nothing listed from SA and NT CEOs. This is curious from a number of angles. In the workshop discussions there was general agreement that for remote indigenous schools student attendance was a critical underlying issue and a crucial foundational cause required for improving numeracy

achievement. If students are not at school, any other intervention designed to improve their achievement becomes moot. Therefore this cause was seen as essential by all groups in their discussions but the urban schools noted that it was not a significant problem for them in their context.

The placing of this cause in different subcategories reflects a subtle difference in how people viewed who was responsible for dealing with this issue. The WA CEO discussion focused on the critical role that families have on the choices that indigenous students make about attending. The SA schools in comparison were dealing with urban student populations with a high migrant cohort. For them the whole community infrastructure was important for keeping students attending.

### Information & Communication Technology (ICT)

***ICT*** is another interesting tiny subcategory, containing only ICT practice and knowledge and connection with e-Learning, both listed only by schools. These causes sum up a large collection of ideas and were also mentioned in other categories under ***school*** and ***future focus***, again only by schools. The issue of technology was discussed in detail by the school clusters during the mapping sessions and at other times but not by the CEOs and DEEWR. This pragmatic recognition of the importance of lesson-facilitating resources as a cause is also shown in the ***tools*** subcategory, which includes the general up to date tools and the more specific workbooks and EMU.

### System: (The quintessentially ambiguous term)

System is used in the most diverse and ambiguous way, appearing in different subcategories in each of the categories of **VISION**, **TEACHING**, **ORGANISATION**, **SCHOOL** and **OTHER**. It appears a total of 11 times, 5 from schools, 4 CEOs and 2 from DEEWR. This term more than any other highlights how meaning is determined within the knowledge cultures of participants. The government personnel created a mega category bubble called **SYSTEM**, see map 6.X below. This concept of system

excludes **TEACHERS**, **TEACHING** and **COMMUNITY**, all categories directly related to schooling and students. In sharp contrast, the NT CEO listed four levels of system for **ORGANISATION** and **EVIDENCE**. These levels correspond to the levels used in this study of Government, CEO, school and classroom.

So the term 'system' is applied to both different categories and different sets of stakeholders from within different stakeholder groups. Thus it provides a clear example where the same term can be used by one knowledge culture in ways that might not be recognised or understood by another knowledge culture. This has implications for policy that will be addressed in the final chapter of this thesis.

### 6.2.3 Stakeholder priorities: The top 3 causes

To answer the research questions data was gathered from multiple mapping activities. After identifying the range of causes required to improve numeracy in low SES schools, participants were asked to discuss and then nominate the top three causes that were critical for improving numeracy. This prioritising activity was intended to shift participants' thinking from considering all the possible causes in the first mapping activity (creating a quantity of causes), to focusing in on the most important causes for tackling the problem (causal quality or priority). This was done to provide a way of comparing the perception of quantity vs quality, as well as provide a more manageable number of causes for comparisons. This section reviews the results from this activity of identifying the top 3 causes influencing the improvement of numeracy achievement in students from low SES schools.

### *6.2.3.1 Observations on the process for identifying the top 3 causes*

As part of the facilitated approach to the mapping sessions, a high degree of freedom was allowed in how people could respond to this activity. This meant that some groups decided that all three choices should be at number one, while other groups concluded that a fourth cause needed to be included. The diversity in response was also shown in the level of detail that was chosen. A number of groups chose a whole category of causes, placing their number against the heading on a specific bubble. Others picked individual causes already placed on the map while a few added a new cause as a summary of a number of different causes.

The results from this activity show that although all the stakeholder groups were able to identify roughly similar numbers of causes for each of the LAND framework categories, they did not value them in a similar way. The findings in this section particularly relate to the following research questions:

4. **Comparisons:** What are the similarities and differences in understandings within and between each group of stakeholders?

5. **Alignment:** What does alignment mean in this context? What are the points of alignment and or misalignment between these perceptions?

Each group reported back to the workshop as a whole and provided an explanation for their choices. This information, like the individual causes, has been collected and is presented in multiple forms: as a map based around the LAND framework, and as a table and related graph. Once again the table does not imply a statistical analysis of the data but just a way of organizing a highly subjective collection of views.

### 6.2.3.2 Top 3 Causes weighted and compared with total revised causes

The responses were weighted, with the number one priorities given a numerical value of 3, the twos 2 and the threes 1. The values for each cause were then added together to provide a score for each LAND framework category. The results are shown in Table #6.6.

***Table 6.6 Top 3 causes & Total causes aggregated by LAND framework***

| | Top 3 | Revised |
|---|---|---|
| Evidence | 12 | 47 |
| Other | 0 | 37 |
| PD | 9 | 52 |
| Vision | 35 | 84 |
| Organisation | 10 | 100 |
| Teaching | 58 | 167 |
| Community | 47 | 197 |
| | **171** | **684** |

The data in Table #6.6 is also presented in the form of a column graph as shown in Figure #6.12.

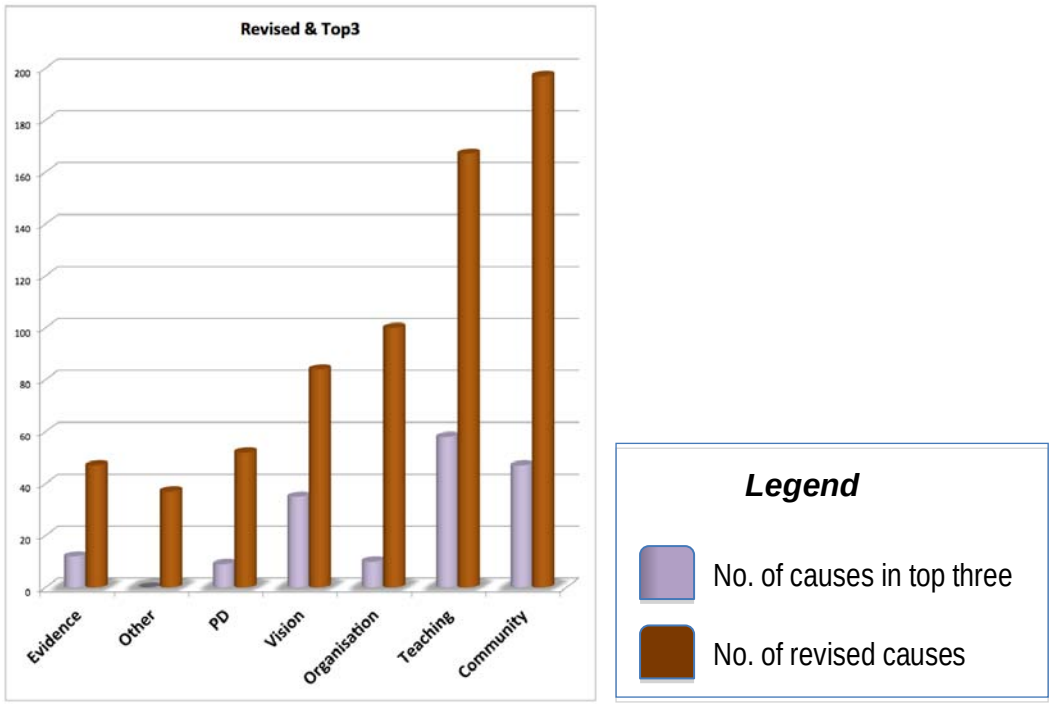


Figure 6.12 Aggregated total of top three causes compared with revised causes

The graph in Figure #6.12 provides a comparison of the profiles of the aggregated number of causes between the top 3 causes and the total number of revised causes identified in the first mapping activity. The profiles of each collection of causes differ in significant areas. The categories with the fewest causes listed in both profiles include **EVIDENCE**, **OTHER** and **PD.** However, **ORGANISATION,** which had the third highest number of causes listed in the revised maps is now the smallest category of the top three causes. This score for **ORGANISATION** is a direct result of participants both attributing it a low priority, and listing few causes against it. **PD** and **EVIDENCE** come next but the causes listed come almost exclusively from the school level of stakeholders.

The three categories with the largest numbers are **VISION**, **TEACHING** and **COMMUNITY**. The latter two categories are still the largest but their positions have swapped, **TEACHING** now rating as the highest priority.

It can therefore be noted from these results that the number of causes identified in a given category does not necessarily relate to the importance stakeholders attribute to it. The numbers from the total aggregated causes place an emphasis first on **COMMUNITY**, then **TEACHING**, then **ORGANISATION**. In contrast, the 'Top 3 causes' activity resulted in the identification of **TEACHING**, **COMMUNITY** and **VISION** as the most important categories. So there is a clear shift in profile from the list of causes gathered from the revised maps to the profile of the top 3 causes. This has implications for both how the problem might be tackled and in the development of relevant policy. The following discussion reviews the selection of causes chosen as their top three for each of the knowledge cultures in the study.

### *6.2.3.3 DEEWR and CEO top 3 causes*

Figure #6.12 provides a visual representation, based on the LAND framework, of the top 3 causes chosen by the DEEWR and CEO stakeholder groups. When choosing

their top three causes, DEEWR participants tended to choose whole categories, with three [1]s attributed to **TEACHING** and the final [1] placed next to **COMMUNITY**. Almost all the [2]s and [3]s were placed in the **COMMUNITY** bubble and were placed next to broad labels such as: attendance, engagement, school, family and local empowerment. There was a single [2] placed in **VISION**: informing improvement and a single [3] in **ORGANISATION**: resourcing.

The contrast with the CEOs is stark. Not only are the top three causes in different categories, but there is no overlap on specific causes. Only the WA CEO located any of their top 3 in **COMMUNITY** and the focus was completely different, with one [1]: students, and two [3]s: prof learning community and prof dialogue. A large number of causes were selected by CEOs in the **TEACHING** category but they were almost all more specific than the DEEWR selected causes. The CEOs identified teaching-related causes such as models of effective practice, pedagogy, school numeracy plan, enquiry mindset and purposeful teaching. While these causes relate to teaching they are not focused on teachers directly. This contrasts with the school cluster's list of causes in **TEACHING** which are focused on the character and skills of teachers and specific numeracy programs.

The other major category for CEOs was **VISION**. All three CEO groups chose leadership as a top [1] or [2] cause, while this was totally absent from either the schools or DEEWR. The other three causes listed in **VISION** were two [2]s: attracting and retaining good teachers and promoting and valuing numeracy, and one [3]: high expectations. Finally, the WA CEO placed a [3] in **ORGANISATION**: school numeracy plan and created a [4] in **OUTCOMES**: data.

In summary, the DEEWR personnel identified broad, non-specific, systemic causes and categories relating primarily to teaching and the community. In comparison the CEO participants selected more specific causes relating to leadership, vision and the activities associated with teaching and professional practice.

Figure 6.13 Top 3 Causes: CEOs & DEEWR

### *6.2.3.4 School top 3 causes*

A comparison between the schools and DEEWR and CEOs shows a superficial similarity. All the stakeholder groups identified causes in the three categories of **VISION**, **TEACHING** and **COMMUNITY**. At this high level of aggregation the main difference is the seven causes listed in **OUTCOMES** by the school clusters versus only one listed by one CEO and nothing by DEEWR. The seven school causes include two [1]s: teacher anecdotal and class observation, one [2]: evidence, and four [3]s, comprising one data and three evidence. Thus the two [1]s were specific examples of evidence gathering and all the rest were the very general evidence or data. This focus on evidence could be explained by the nature of the PD topics chosen for workshop #3 in the LAND project. Schools were being asked to demonstrate the improvements in their school's numeracy by presenting relevant data or evidence. Therefore it would be reasonable to assume this area was uppermost in the minds of this group of stakeholders.

Examination of the detail of the causes selected by the school clusters for the top 3 highlights a complex mix in the results, with differences in stakeholder perspectives appearing to be affected by the immediacy of the issues being confronted at any given moment. This was evidenced during the final workshops when four different groups mentioned that their focus had shifted since they had first chosen their top three causes and that their choices were now different.

The **ORGANISATION** category shows a contrast between the schools and DEEWR and the CEOs. The latter two groups only listed [3]s in this category while the schools listed a single [1]: supporting programming, and two [2]s: support for working together and PLC maths clusters.

**VISION** includes contribution from three of the four clusters with no representation from WA Perth. NT listed **VISION** as both a [1] and a [2], while SA had two [1]s against united in desire for student best. WA Broome had a [2]: ongoing evolving

improvement, and a [3]: thinking about improvement. In each case there was a similar focus within the cluster, but not between clusters. This highlights that differences and alignment or misalignment occur in a number of ways, both between stakeholder levels and between stakeholder groups within each level.

**COMMUNITY** included causes from all four school clusters, mostly ranked [1]. NT and Broome both had students (motivated) numbered as multiple [1]s or a [2]. In comparison SA and Perth both focused on school related issues such as culture, support teachers, assessment and whole school approach.

All school clusters also placed causes in the **TEACHING** and **PD** categories, with most being [2]s and [3]s. Again the remote and urban schools align in the types of causes listed. Broome and NT focus on teachers, including as a remote team, human capital and building teacher capacity. The urban WA and SA schools were more conceptual and attitudinal, picking big ideas, commitment, positive attitude, confidence and knowledge.

In summary, the school cluster top 3 causes map (see Figure #6.12) shows a mixed collection of contextualised causes that relate directly to the perceived immediate work issues of participants.

Figure 6.14 Top 3 Causes: School Clusters

### *6.2.3.5 Top 3 causes conclusions*

Choosing the top 3 most important causes allowed participants to place a priority on what causes were most central for them. When the results were aggregated and placed on a map of the LAND framework there is a discernable shift from the profile of the collection of causes aggregated from the revised maps. The highest scored categories from the revised maps, **COMMUNITY**, **TEACHING** and **ORGANISATION**, became **TEACHING**, **COMMUNITY** and **VISION** on the top 3 map.

The observations of the specific causes selected by the different participant groups have shown that each group had their own distinctive pattern of the types of causes chosen. DEEWR identified broad, non-specific, systemic causes and categories relating primarily to teaching and the community. The CEO participants selected more specific causes relating to leadership, vision and the activities associated with teaching and professional practice. Finally the school clusters selected a mixed collection of contextualised causes that relate directly the to the perceived immediate work issues of participants.

This concludes the review of data collected from all the stakeholder groups. The next section discusses the findings from the final LAND workshops that only involved the school cluster participants.

### 6.2.4 School Clusters: Comparing linked top 3 causal maps

During the final LAND workshops, linked causal maps were produced by school cluster groups. A3-sized pages were presented to each group containing a map of each cluster's own collection of top three causes as per the LAND framework. The groups were then asked to link the various causes with lines and arrows, including descriptions on the links to show how one cause related to another. They were also asked to show on the map where someone should start so as to interpret the causal flow on the map. This process was based around a collaborative dialogue with one person acting as scribe. This activity provided the opportunity for gathering data on the following research questions:

**Comparisons:** What are the similarities and differences in understandings within and between each group of stakeholders?

**Alignment:** What does alignment mean in this context? What are the points of alignment and or misalignment between these perceptions?

**Causal linkages:** What linkages do individuals and groups make between different factors and in what directions?

The constrained parameters of this activity made comparisons between maps and identification of alignment easier to identify because the nodes on the map were limited, fixed and the same for every group in a cluster. It also provided a means of assessing the perceived wickedity of the problem in a general sense. For a tame problem the maps should have a high degree of similarity since there are only a limited number of possible points of difference as shown in Table #6.7, and the perspectives of stakeholders on the causes of the problem should show some alignment (see the comparison of tame and wicked problems in Table #2.2).

| *Table 6.7 Elements for comparison of causal maps in final workshop* |
|---|
| Selection of starting point |
| Additional nodes created |
| Selection of which nodes to link (Complexity & Density) |
| Single or double arrowed lines |
| Direction of arrows on links |
| Descriptors on links |
| Additional annotations |

In contrast, for a wicked problem the likelihood is that maps will demonstrate a high degree of variability even within these limitations. This variability was borne out by the completed maps, with few examples of alignment between participant's maps. The details of these comparisons are presented in the following sections, using each of the map elements listed in Table #6.x.

### *6.2.4.1 Selection of starting points*

Participants were asked to designate the starting point for understanding the causal flows on their maps. The matrix below shows all the starting points selected by the different clusters. At first glance there appears to be some similarity and alignment between groups with the majority listed next to 'none' in Table #6.8. This shows that 12 groups chose not to place any starting point on their map, but their reasons turned out not to be the same. Some did not know where to start, others considered that you could choose to start anywhere on the map, and some groups formed causal loops that by their definition did not have a start or finish.

| *Table 6.8 Final Workshop Maps – Starting points* | | | | |
|---|---|---|---|---|
| Category | SA | NT | WA-B | WA-P |
| None | 1 | 3 | 4 | 4 |
| Vision | 2 – combined with school (in community) | 2 | | 1- combined with Community |
| Teaching | | | 1 | |
| Community | 1- school | | | |
| Organisation | | | | |
| Evidence | | | | |
| PD | | | | |

**VISION** was the LAND category selected by most groups as a starting point but once again there are significant differences in the detail. Around half of SA and NT groups started with **VISION** but the SA people combined this with ***school*** and one Perth group chose **VISION** combined with ***community***.

The final two starting points were a WA-B group starting with teaching and one SA group choosing ***school*** within **COMMUNITY**.

From these results it is difficult to identify any alignment between groups on the basis of where they consider one should begin in tackling the problem. A tentative claim could be made that either there is no particular place to start for tackling this problem or that **VISION** is the only category that has backing from a number of cluster groups.

### *6.2.4.2 Additional nodes created*

This map element adds little to the findings as there were almost no additional nodes created. No WA groups added nodes and only one SA group created an additional node, titled 'clearly articulated goal'. This had a centralising role linking **VISION**, ***school***, **TEACHING** and data.

The one point of alignment between groups was the addition of ***students*** to any maps where it was absent. The NT map did not have ***students*** identified because it was not originally selected as a top three cause. All the finished maps either added it or drew a line to where it would be in the LAND framework. When questioned, each group noted that this had always been a concern for them but the LAND framework helped make its absence obvious. Therefore a claim can be made that all participant groups perceived the LAND framework as providing a valid underlying collection of categories that could be used to explain the wicked problem under discussion.

### *6.2.4.3 Selection of nodes to link – Complexity and density*

In spite of the limited parameters there is little consistency between maps from the same clusters. On some maps nodes were grouped with a bubble and the bubbles were linked, while on others links were made from individual nodes. Some groups made only a few links, although this was not always a reflection of the complexity of the dialogue, while others were quite dense with many nodes linked in multiple ways. Therefore this map element does not provide any evidence of alignment between participants in either the complexity or density of maps.

### *6.2.4.4 Causal linkages (lines - arrows – direction)*

There were almost as many combinations of links and direction of links as there were maps, so that overall there is no discernable pattern when comparing participant maps. Most maps contain single pen stroke lines (links), with double arrows meaning that both causes (nodes) affect each other. A few maps contain some thickened lines for emphasis and most maps contained at least a few single direction arrows. Some maps had no arrows at all, looking more like the model for the LAND framework than a causal map. As with the other map elements the link between causes does not provide evidence of alignment between participants.

As a response to the research question on causal linkages the evidence from these maps would suggest that even with limited parameters there is so little consistency between the maps of participant groups that it is impossible to draw generalizable conclusions about the perceptions of the different cluster groups involved in the activity.

### 6.2.4.5 Descriptions on links and extra annotations

Almost all the maps provided some descriptors on their links, ranging from one-word comments to lists of dot points. Comparing these annotations does not demonstrate consistent similarity between maps, but some words and phrases such as, 'drives', 'developed', 'leads to' and 'needs' do appear with some regularity. Since these are general terms for causal relationships they provide no specific insights into the relationships between causes.

### 6.2.4.6 Comparison of linked causal maps conclusions

The linked causal maps provided an opportunity for making comparisons between the perceptions of school cluster participant groups through the use of seven map elements. There was little consistency or alignment between the maps, which demonstrates a high degree of wickedity.

A few similarities in the maps could be put forward as evidence of some form of alignment. First, the LAND framework appears to have been seen as a valid foundation by all participant groups for discussing the causes related to improving numeracy in low SES schools. Second if there is any place to start with dealing with this problem it relates to the **VISION** category on the LAND framework.

When the individual causes chosen by each group are assessed there is little alignment in either the type or focus. DEEWR personnel selected broad, non-specific, systemic causes and categories relating primarily to **TEACHING** and the **COMMUNITY**. The CEO participants were more specific but primarily selected causes relating only to ***leadership***, **VISION** and the activities associated with **TEACHING** and professional practice. The school clusters were highly contextual in their choice of their top 3 causes, selecting specific concepts that related to their school/work environment at that time. **VISION**, the character and skills of **TEACHERS** and specific numeracy programs were the standard categories for

these stakeholders. These results demonstrate that differences and alignment or misalignment occur in a number of ways, both between stakeholder levels and between stakeholder groups within each level.

A final observation can be made about these maps. As a visual tool, participants not only drew abstract lines on their maps, but also created drawings or mini models somewhere on their map. These appear to have been the group's way of making sense of the complexity of the information on the map. Some drawings summed up some of the concepts or were used as a unifying representation of key relationships.

For example, one group drew a dog's head, seeing the shape of a dog emerging as they drew their map. When asked about the point of this illustration I was told that it helped them remember the main points.

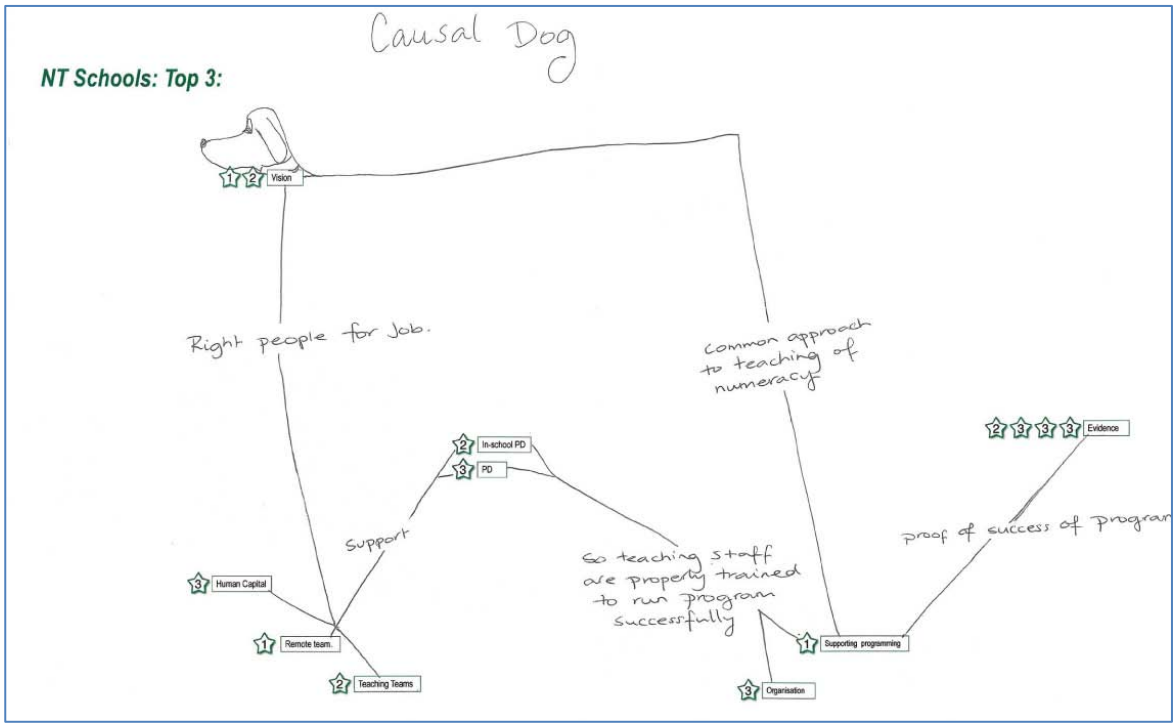


**Figure 6.15 Example of visual fun and memory jogger**

Others summed up part of the map with an additional drawing as shown below by the 'umbrella' causes and the significant teacher stick figure. In each case there is both an element of fun and a way of visually representing a key point.

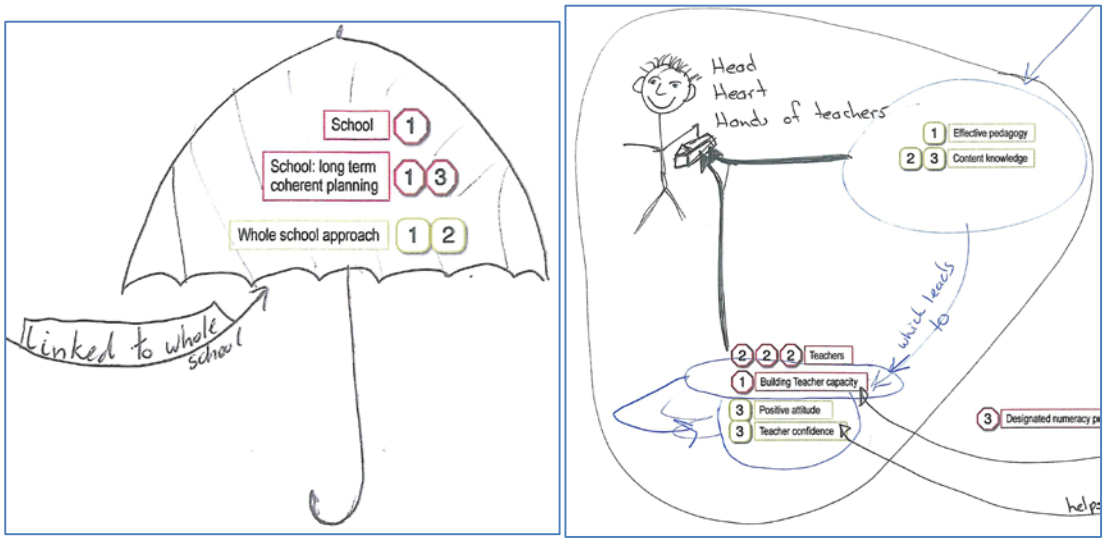


**Figure 6.16 Part X and Y. Examples of mini models**

This completes the review of the group mapping activities. Before discussing the implications of the findings of causal maps for the concept of alignment, the next section will present the findings from the maps created by individuals.

### 6.2.5 Individual causal maps

As part of the workshop #3 mapping session the participants were each given an A3 sheet of paper with a small box on the right-hand side, labelled 'improved numeracy'. Each participant was asked to create an individual causal map by selecting a cause significant to them and placing it on the left of the sheet. They were then asked to make a map made up of nodes and links connecting their chosen cause at the left to 'improved numeracy' at the right. Instructions were deliberately open and simple, using the causal mapping techniques just learnt.

Most of the maps created conformed to the minimum requirements needed to constitute a causal map and therefore could be used to make comparisons. In making such comparisons, 'nodes' stand for causes, while 'links' represent relationships or associations. (Vo, et al., 2005, p. 144)

#### *6.2.5.1 Causes identified through the individual mapping activity*

The specific causes selected by participants for this activity were categorised and mapped onto the LAND framework as shown in Figure #6.17. At this level of analysis there is a general similarity between Figures #6.17 and #6.8-9 (showing the top three causes maps), with three categories dominating, these being **VISION**, **TEACHING** and **COMMUNITY**. Each level of participant group is represented in these categories except for the WA CEO in the **TEACHING** category. In comparison to the latter point, **TEACHING** is the most significant category for WA schools.

There are, however, a few differences observable between the different states and territories. SA schools and their CEO stand out in not selecting any causes in the **COMMUNITY** category. The NT schools similarly stand out in the **TEACHING** category with no causes listed, which contrasts with the large number of teaching-related causes listed from each of the other school clusters.

The specific causes selected by participants in each group are listed in Tables #6.9a and #6.9b, and once again this more detailed level of the findings presents a pattern of similarities and differences between the various stakeholder groups.

**Figure 6.17 Specific Causes Selected for Mapping placed on the LAND framework.**

| Table 6.9a Causes selected for individual causal maps: Schools | | | | |
|---|---|---|---|---|
| | South Australia | Northern Territory | Broome WA | Perth WA |
| 1 | eLearning | Leadership Support | Building teacher capability & efficacy | Growth points for student assesment |
| 2 | Explicit teaching | Vision | School long term coherent planning | Staff sharing |
| 3 | Effective mental strategies | Community | Example of ICT | Supportive admin team |
| 4 | Early intervention strategies | Student's attitude, belief | Teacher knowledge | Whole school approach |
| 5 | Open to PD opportunities | Students | Motivated students | Shared responsibility |
| 6 | Early career teacher development | Organisation | Develop a sense of purpose | Differentiation |
| 7 | United in desire for student best | All staff planning | Develop a sense of purpose | Willingness to try new things |
| 8 | Vision: Increase awareness | Programming | Higher attendance | Cater for all students |
| 9 | Project partnerships | Vision | National curriculum | Effective pedagogy |
| 10 | Time allocated to PD | PD | Improved teacher confidence in Numeracy | Knowledge of students through assessment |
| 11 | Resources | School | Building teacher capability & efficacy | Knowledge of content |
| 12 | | PD Support | Local culture & environment | |
| 13 | | Parent community involvement | | |

| Table 6.9b Causes selected for individual causal maps: CEOs & Govt. | | | | |
|---|---|---|---|---|
| | South Australia | Northern Territory | Western Australia | Government |
| 1 | Principal as leader of learning numeracy | Retaining quality teachers | Leadership | Aus Gov funding Influence |
| 2 | Promoting Numeracy | | Professional Dialogue | Culture of learning |
| 3 | Develop teachers understanding of N | | Professional Dialogue | No cause listed |
| 4 | Maths understanding | | Used LAND framework | Quality Teaching |
| 5 | Develop Numeracy | | Students | Leadership |
| 6 | Maths understanding | | Students | Local empowerment |
| 7 | Learning | | Leadership | Improving N for LOW SES Students |
| 8 | | | Using Data | Student attendance |
| 9 | | | PD | |

### 6.2.5.2 Making sense of individual maps

There were seventy-four individual maps collected as part of the data for this study. The variety of these maps was immense, each map being a unique expression of an individual's thinking at the time of the workshops. There are however some points of commonality. These are now discussed through reference to both the specific causes selected and some exemplar maps that give a sense of some of the patterns that emerged.

### 6.2.5.3 DEEWR individual maps

The government personnel selected causes for this activity that correspond in nature to the collection of causes they had previously identified. The focus of the causes selected revolved around government's influence, leadership, quality teaching and the culture of learning. All the causes were general and high level, acting as broad headings rather than specific issues of concrete examples.

Five of the eight maps developed by the DEEWR participants were similar in appearance to those from other groups, however several were distinctive showing some unusual ways of thinking and representation. For example, Gov-1 shown in Figure #6.18 was particularly dense, although the links were not annotated. The comment made by the author in a slightly exasperated way was that "almost everything is connected to everything else". This sort of view was held by a number of government participants but few expressed this in their maps. Instead, most willingly 'tamed' the visual representation of their wicked complex problem to make it more manageable.

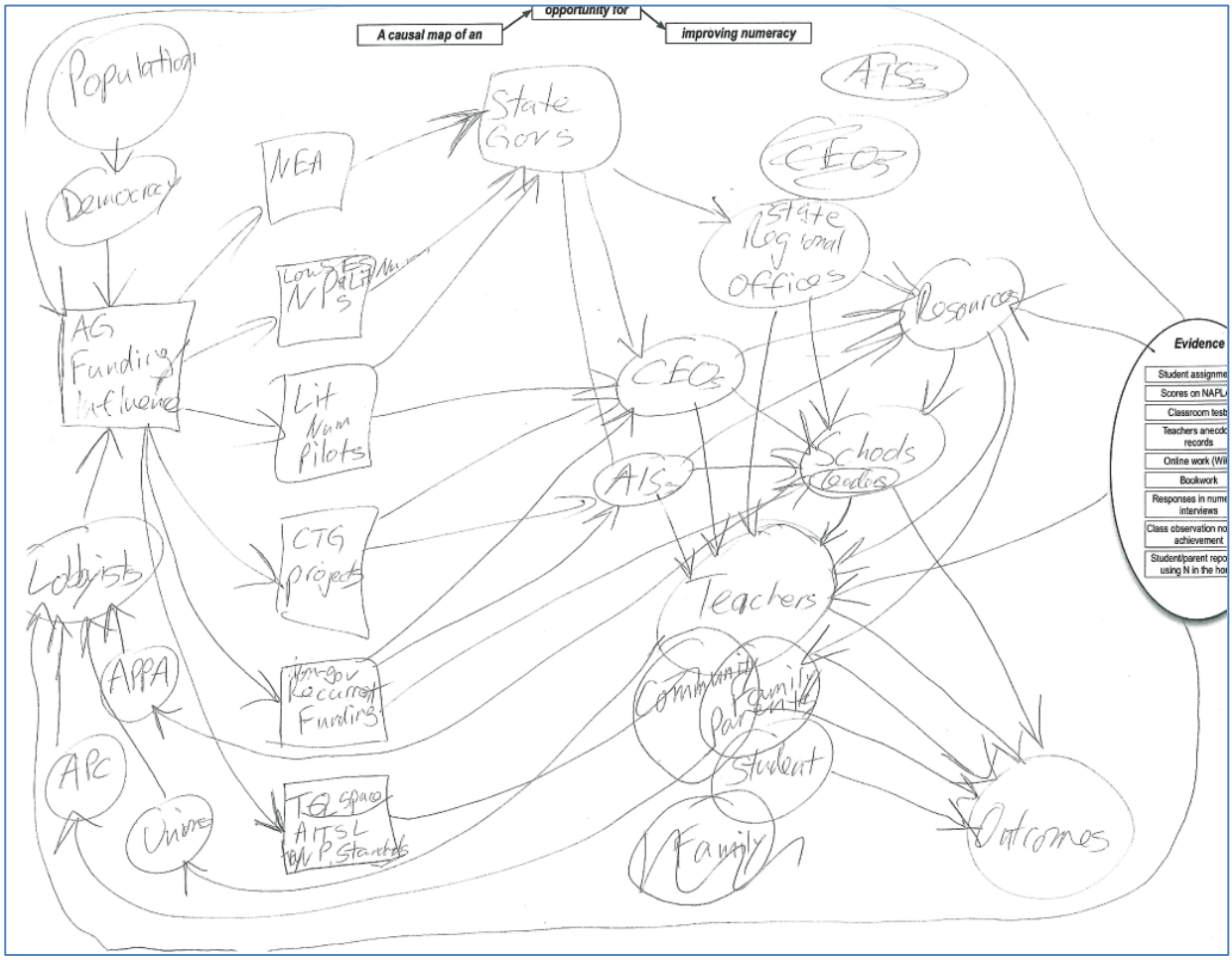


**Figure 6.18 Gov-1 Example of very dense map**

Figure #6.19 provides a second example, in this case showing a highly directional map. Lines only have arrows going in one direction. The strength of relationship was shown through the use of double arrow-heads. All the arrows move away from the starting point of leadership left-to-right, with no arrows moving 'backward' from right-to-left. The map is not dense but it is non-linear and clear. This would seem to indicate that this person understood the relationship between causes as functioning in only one direction. This was common to other individual maps but contrasts with many that placed arrows at both ends, indicating that both causes impacted on each other.

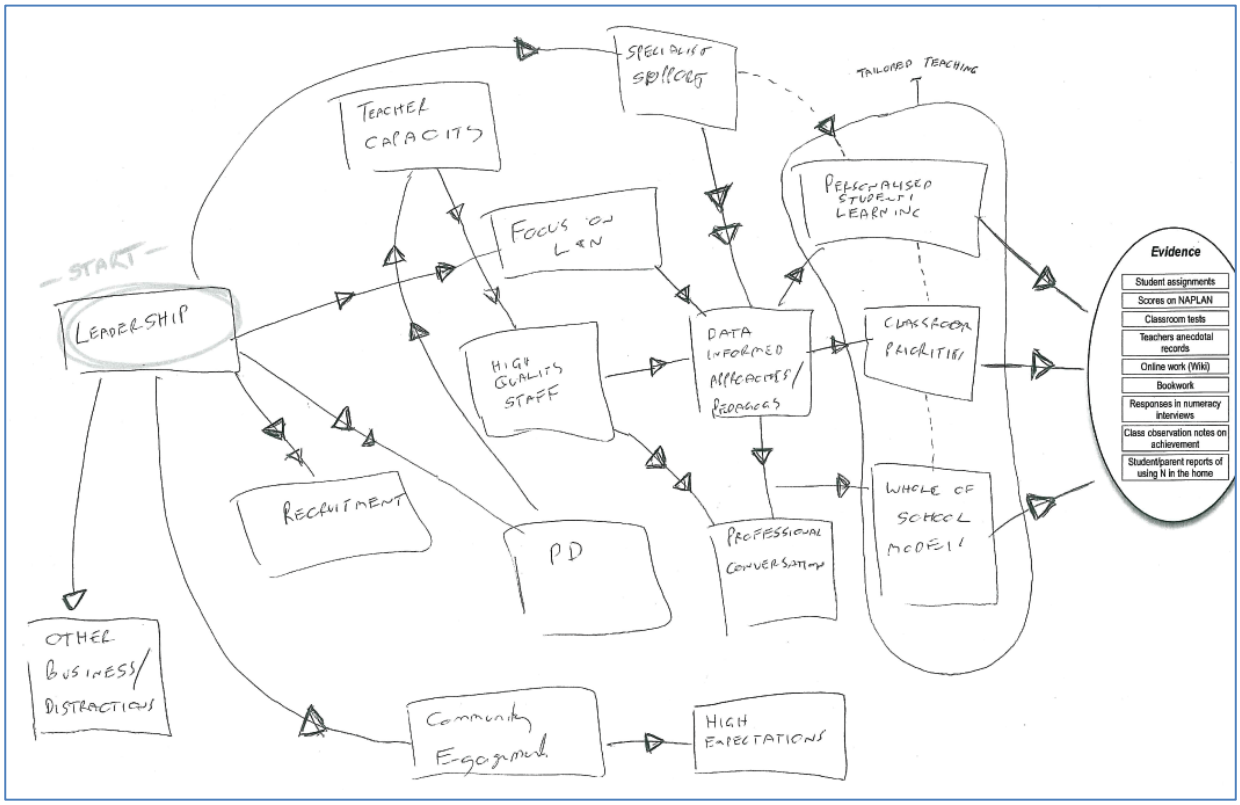


**Figure 6.19 Gov-5 Example of highly directed map**

The final example of individual mapping from the DEEWR participant group is shown in Figure #6.20. This demonstrates a desire to 'tame' the problem. The author, in trying to make sense of causal mapping, decided that it "is just the same as policy development", which enabled her to clearly and quickly develop a 'map'. What was drawn is a classic policy development model and bears no resemblance to what was required for the activity. The model is simple, clear and very linear, easily reduced to a list or text. When I enquired as to her thinking she explained that this model shows the "sort of thing they do everyday for developing policy" but then corrected herself and said "of course it doesn't work this way" and went onto describe a complex, iterative and non-linear process, none of which was drawn on her map.

This imposition of a disciplinary model for policy making onto a totally different activity, causal mapping, demonstrates one of the limitations of boundary objects: they can be co-opted by one knowledge culture and used to reinforce cultural norms rather than challenge them. This is where the dialogue and the role of the facilitator

are important. If more time had been available we could have examined this map in more detail and possibly developed this person's thinking to consider how their verbal comments could be incorporated into a revised map that would more accurately present their actual thinking about the problem.

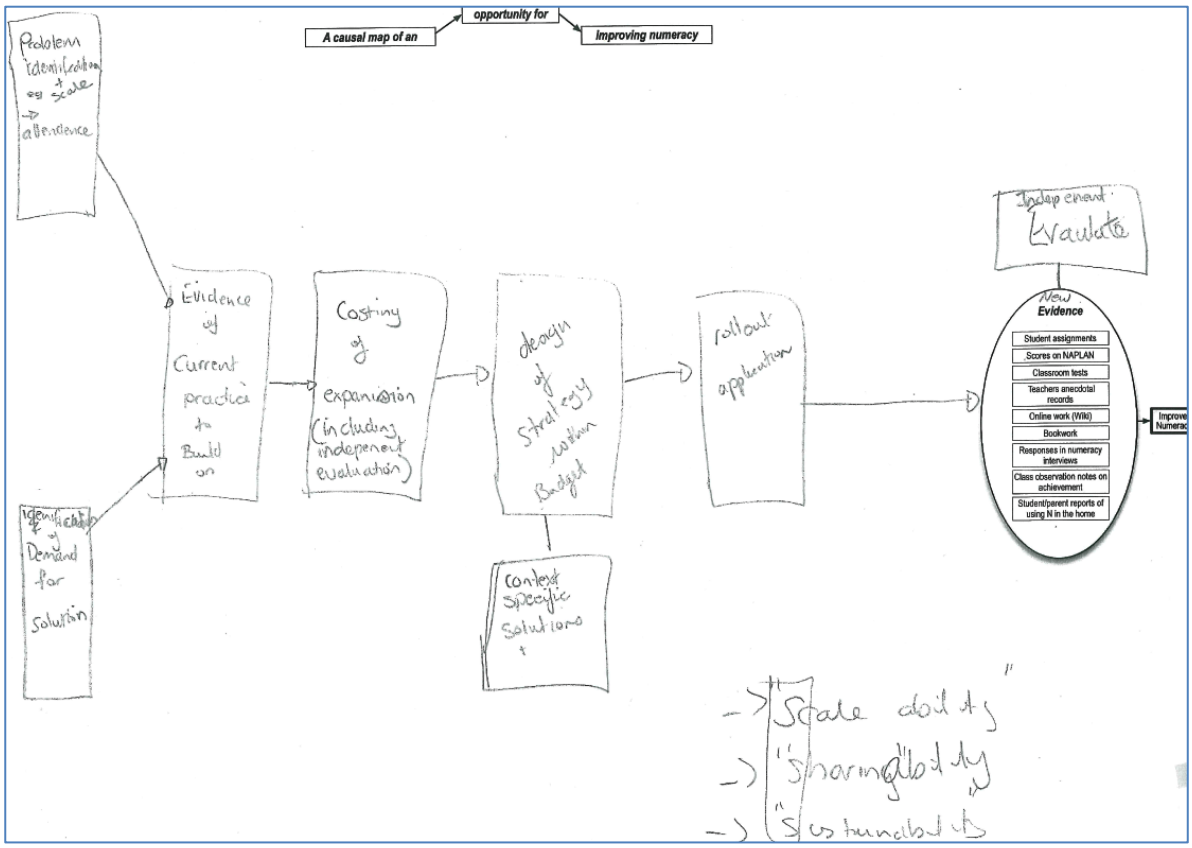


**Figure 6.20 Gov-3 Example of mental model overriding mapping process**

### *6.2.5.4 CEO individual maps*

The individual maps created by CEO participants ranged in scope, focus and layout. The causes selected by each CEO had internal similarities that reflected the collaborative dynamics and history of that group of people. This is a critical finding and will be discussed in detail in Section #6.3 on the map-making process.

One of the CEO groups elected to use the same cause, retaining quality teachers, which provided the opportunity to compare how members of a single group construct maps at the same time, given the same initial cause and desired effect. Their process

also provided an insight into how a number of their maps grew and developed. Since this relates so intimately to the map-making process it is discussed in Section #6.3.3.1.

The other two CEO groups elected to choose their own topics but the ongoing dialogue drew many to similar areas of interest. One group selected causes that related directly to numeracy, while the other group chose ones related to three topics: leadership, students and professional dialogue. This demonstrates one of the outcomes from collaborative dialogue. Those directly involved in the dialogue moved to a closer alignment on emphasis and topics of interest.

#### *6.2.5.5 School cluster individual maps*

The school cluster groups developed their maps in a similar manner to the CEO groups. There was a range of topics in each group but dialogue and history resulted in an emphasis and focus on particular concepts and issues. The group from South Australia selected a number of causes directly related to teaching and teacher's professional development (PD) but included no mention of students. In contrast the Northern territory cluster emphasised students, organisation and planning as well as PD.

The two Western Australia school clusters had the widest range of topics including causes related to the knowledge of students, numeracy, maths and teaching. There were also a number of causes that could be grouped around the concept of corporate responsibility and support.

The look of the finished maps was quite diverse in terms of the use of links, arrows and linking comments. All the groups included examples of maps that contained no arrows, with links shown only as lines. Maps with single and double-ended arrowed lines were also represented in all groups. Comments on the linking lines were more predominant in the west Australian school clusters and the WA CEO.

In conclusion, the individual maps displayed some similarities within groups but taken as a whole the result is primarily one of diversity. It would be unlikely that these maps could be synthesised to present a single, coherent perspective on the causes related to improving numeracy in low socioeconomic status schools. This and the previous findings in this chapter have implications for the concept of alignment and this will now be addressed.

### 6.2.6 Alignment

Alignment was a key feature of the LAND project and has been identified as a critical issue in educational improvement and transformation (Herman & Webb, 2007; Watterston & Caldwell, 2011). However, there are significant differences in the literature regarding the meaning of 'alignment', who and what it includes, and how it can be achieved. The OECD working paper on educational alignment, by Looney (2011) divides the topic into two major headings:

1. Technical alignment: including standards, curriculum and assessment

2. Social alignment: including school level collaboration, teacher motivation and school improvement

Other educational research on alignment has included focuses on:

- 'effort' among and between the different levels of government (Watterston & Caldwell, 2011, p. 638)
- standards and assessment across the various levels of the education system (Herman, Webb, & Zuniga, 2007)
- processes for determining quality teaching and learning (Beck, 2007)

- curriculum, policy and classroom practice (Herman & Webb, 2007, p. 2)
- individual teachers, groups of teachers, schools, regions and states (Herman & Webb, 2007, p. 3).

Common to all of these approaches has been agreement that "for the system to work its elements must be aligned" (Herman & Webb, 2007, p. 3). In comparison to these broad parameters in the literature, the research questions for this study, presented in chapter #1, are quite modest and narrow in scope. They are:

- What does alignment mean in this context?
- What are the points of alignment and or misalignment between these perceptions?

Up to this point Chapter #6 has presented the various similarities and differences in participants' listing of the causes required to improve the numeracy achievement of students in low socioeconomic status schools. The patterns emerging from these findings provide insight into each stakeholder group's thinking regarding problem causes, rather than the actual causes themselves. Therefore the scope of any discussion on alignment related to this research can only address perceptions and not the 'realities' of system elements and processes.

So in this context alignment can be judged on how much the participant knowledge cultures are going in the same direction on:

- causal **focus:** the range of topics identified in the list of causes
- causal **emphasis:** the characteristics of the presentation and meaning of causes listed

It has already been noted that when the data is aggregated to high-level totals of causes there is a general alignment with the LAND framework. Each of the LAND categories is represented by inputs from all the stakeholder groups. However, this

appearance of alignment is shattered when looking at the data at a more detailed level. Review of the contributions from different knowledge cultures at the category and subcategory levels show patterns of both similarity and difference, leading to the conclusion that there is little alignment between the different knowledge cultures of the participants in this study.

#### *6.2.6.1 Alignment of causal emphasis*

Examining the characteristics of stakeholder responses in these findings demonstrates a number of patterns of causal emphasis. Each stakeholder group indicated a range of causes, but clearly discernable emphases emerged that set each group apart from the others. Figure #6.21 represents this subjective assessment of emphasis as a radar graph. The emphases of school clusters, CEOs and the Government personnel are shown in blue, red and green respectively.

The completed graph has been created by joining the rankings on each spectrum. Points for each group were plotted on the following four series of subjective spectrums:

- Immediacy to long term
- Specific to big picture
- Concrete to theoretical
- Classroom level to federal government level

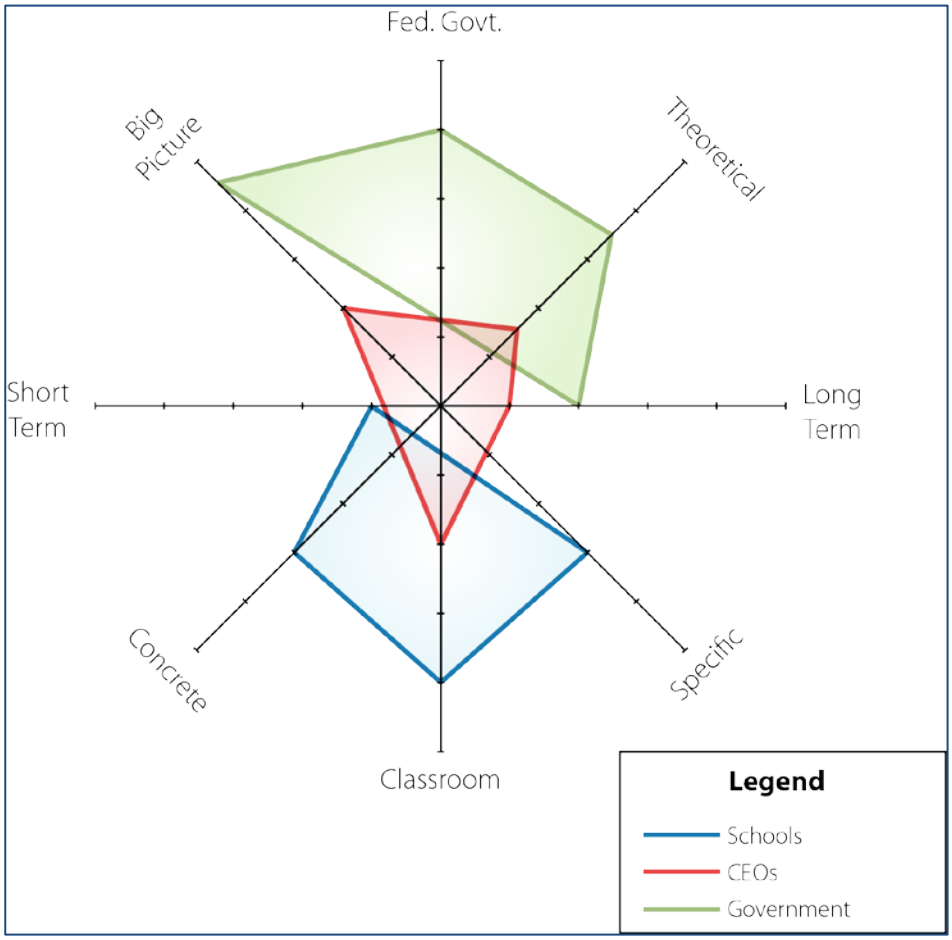


**Figure 6.21 Knowledge culture responses plotted on four spectrums of causal emphasis characteristics.**

The plotting of emphasis shown in figure #6.21 shows little overlap between the three groups. School clusters and DEEWR have a clear gap between them, being on the opposite sides of the centre point of each spectrum. The CEOs have the middle ground, overlapping in part with both the other two groups. This visual representation is not surprising when the specific work contexts of each group is considered, but it does show that, regarding emphasis, there is little alignment between the groups on any of these spectrums.

The causes listed by schools were mostly specific, set at the classroom or school level, and concrete. Causes also ranged from short to long term but most were focused on the short to medium term.

In contrast the DEEWR personnel have been shown to use terminology that is very 'big picture'. They were also the only group to place the federal government as

central to the 'system' and many of the causes listed can be seen as quite abstract or theoretical in nature.

The CEO acts as a bridge between the Government and school groups both on the graph and in their role in the education system. The descriptions of the various CEO groups in this chapter have also shown that this group as a whole was the most internally diverse in their emphases.

One final element of difference relevant to alignment was the lack of causal linkages presented by the school clusters. This has already been noted in Section #6.1.6, where it was observed that in contrast to the school responses, the limited number of DEEWR responses contained numerous causal linkages, including a causal loop. Whatever the reasons for this it means that in any discussion on this wicked problem there is a lack of alignment between the groups in their thinking on what and how causes are linked. This suggests that any policies or mooted interventions that assume a particular chain of cause and effect required to improve numeracy may be contested by the various stakeholder groups.

### *6.2.6.2 Alignment of causal focus*

Chapter #7 will apply the Niche Framework to the results, but in summing up the responses to the question, 'What are the top 3 causes?', each main stakeholder group focused their responses on a different part of the Niche framework, as follows

- DEEWR personnel had a focus related to the system loop
- The CEOs focused on certain aspects of the people loop
- The school clusters focused on different aspects of the people loop and some causes related primarily to the context loop.

These differences in focus could be used to make the claim that there is limited alignment between the different stakeholder groups in their perspectives on what are the most crucial causes related to the wicked problem of trying to improve numeracy achievement in students from low SES schools.

### 6.2.7 Stakeholder patterns of understanding of the causes of the wicked problem: Conclusion

This concludes the first of the two major sections on the findings from this study. The observations in this section show that there are discernable patterns of understanding for each of the knowledge cultures, represented in the participant groups. These groups represent three levels of the educational system, schools, CEOs and the Federal Government. Figure #6.21 on alignment showed that the three groups differed in emphasis in their chosen terminology in at least four main ways: immediacy, specificity, concreteness and level of educational system. There were also discernable patterns of distinctiveness between groups in their causal focus.

The second major section in this chapter reviews the findings as they shed light on the process of causal mapping as a tool for tackling wicked problems.

## 6.3 Causal Mapping As A Process For Tackling Wicked Problems

The second thread of research questions in this study focuses on the collaborative workshop process, using causal maps, and asks the core question, 'Does this process improve participants' understanding of the 'wickedity' (Bore & Wright, 2009, p. 254) of the problem through the use of boundary objects?' In other words, do participants grow in their shared understanding of the six dimensions of wicked problems identified in the literature and expressed in the Niche wicked problem framework.

The original research questions for this thread are based on four dialogical learning mechanisms (Akkerman & Bakker, 2011, p. 151) linked to the use of boundary objects: identification, coordination, reflection and transformation. Before addressing each of these questions I will first make a few observations on some issues that emerged during the workshops related to the process of map creation. Together, the discussion on the mapping process and the dialogical learning mechanisms serve to recap and summarise what has been presented to this point in the findings in chapter #6.

### 6.3.1 Linked causal maps as artefacts of dialogue

Chapter #5 on methodology presented the arguments for not using the standard quantitative analytical criteria of causal map complexity, density and distance ratio, or the subjective criteria designed to assess the accuracy of maps against an objective problem. This decision was borne out by observing the various dialogues associated with the formation of the different causal maps. The finished map drawings were an artefact of the thinking and collaborative dialogue engaged in by the members of a group. The map shown in Figure # 6.22 provides a stark example.

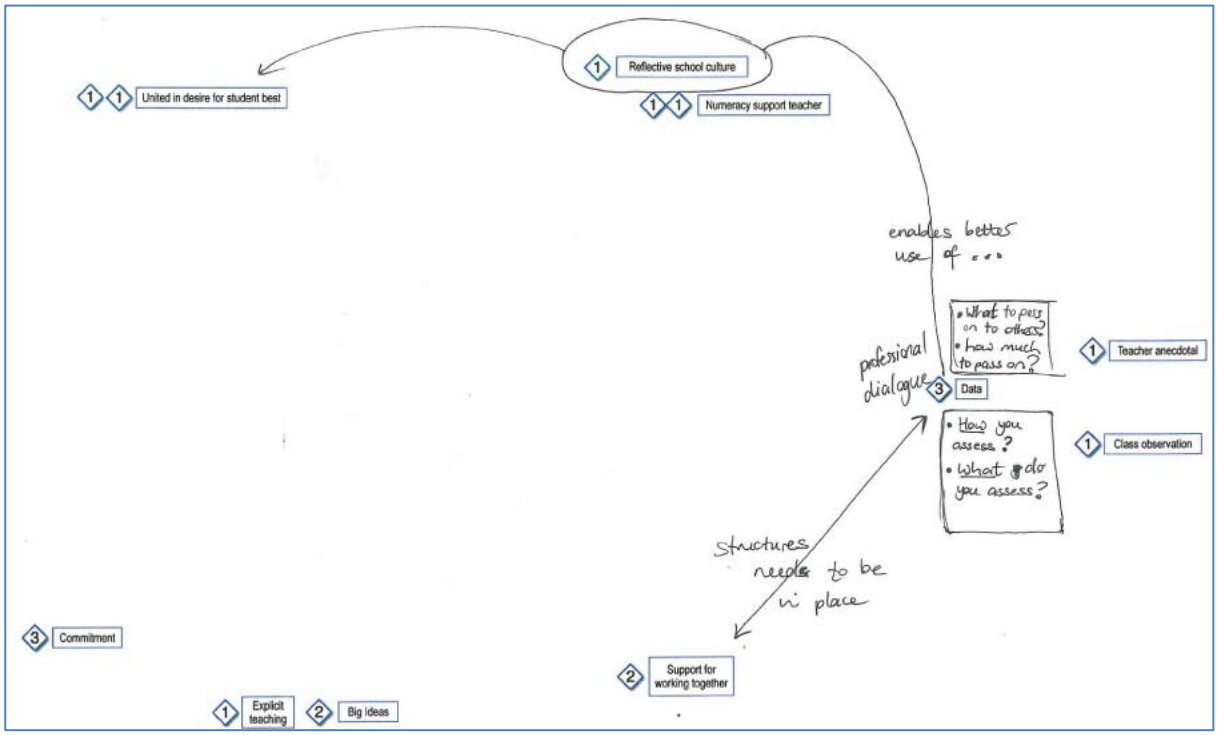


**Figure 6.22 Example of complex high-level dialogue leading to limited map representation**

On face value this map is a limited representation of the problem under review as it contains few links between causes, and half the map has no notation at all. However, observing the discussion painted a very different picture. Although only a few aspects of the wicked problem were addressed, the dialogue that accompanied each step of the map drawing was deep, sophisticated, prolonged and very satisfactory for the people involved. This school group was highly collaborative and respectful of each other's opinions, with each point thoroughly discussed and considered before moving onto the next. The additions written on the map to sum up the conversation were also discussed and the most cogent labels agreed to by all.

This approach to dialogue and mapping meant that (after forty-five minutes), the map only had three links connecting four nodes, but the richness of the discussion was such that the group declared they would be using the map for further planning discussion back at their school. The map thus functioned as a boundary object for tapping into and directing the strategic thinking of the group members.

### 6.3.2 The Individual causal map making process

The different ways participants interacted whilst drawing their maps had a significant impact on which issues they focused on and how their maps were developed. There were three stages to the individual mapping activity, each of which could be done individually (Ind) or collaboratively (Col) thus creating six possible mapping process dynamics. Participants were initially instructed to create their own maps individually and then discuss them with colleagues for comment and editing, creating an Ind-Ind-Col dynamic for the process. However, I invited participants to interact in any way they felt most comfortable as a means of promoting a more relaxed collaborative environment. Consequently, a variety of interaction dynamics occurred. The nature and quality of the collaboration during the mapping activities appeared to relate to the previous history of collaboration that group members had with each other. The mapping process could be said to supplement, develop, amplify or encourage collaboration depending on each group's prior history. The following sections provide examples of some of these dynamics and the nature of the interactions observed. For a few people, the mapping process was too much of a challenge and they created lists of causes instead. This subgroup is addressed first.

#### *6.3.2.1 Difficulties with drawing causal maps*

A few participants had difficulty with the individual mapping activity. For some the problem appeared to be with the act of drawing and/or the non-linear aspect of nodes and links involved in map-making (see Figure #6.23). For others the problem lay not with the process of nodes and links but with the underlying thinking required relating to cause and effect.

The map shown in figure #6.23 is an example of where a participant made a list of causes. This was found to result in either no map being drawn or a map made from the list. This phenomenon has been noted by Craig (2000) who states that people

who are more 'left brained' find the linear nature of lists more accessible than the non-linear mapping process. This aligns with comments from participants in this research and demonstrates a limitation in the use of this research tool for some people.

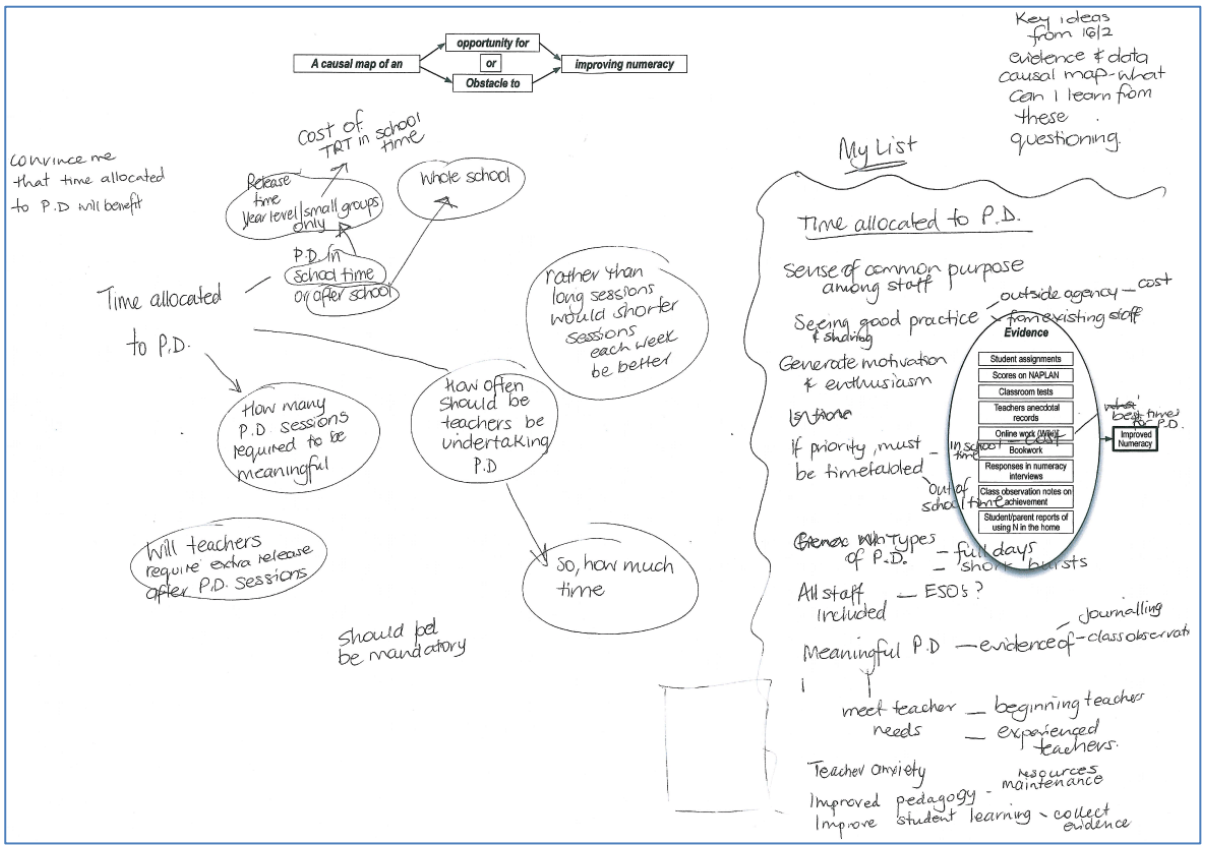


**Figure 6.23 Example of Individual work with no collaboration or editing.**

### 6.3.3 Causal map-making dynamics: Exemplars

The following exemplars highlight some of the ways that groups interacted during the map creation process. Each presents a different combination of individual and collaborative work as well as a description of some of the history and observations of the relationships between group members. Each of these factors impacted on the finished map as an artefact and demonstrates that getting a full picture of a person's map requires an understanding of their relationships and contexts.

### *6.3.3.1 Team collaboration history exemplar 1 (Col-Ind-Col)*

One of the Catholic Education Office groups provides an example of collaboration at two of the three stages of the mapping activity (Col-Ind-Col). They explained that they did not have a history of collaboration; this was therefore the first time they had sat down together to discuss what is involved in improving numeracy in their system's schools. To make the most of their sharing of ideas and strategic thinking they chose to select for their individual mapping the same cause, retaining quality teachers, as being the most significant. As with the final workshop activity, this provided an opportunity to compare how members of a single group construct maps at the same time, given the same initial cause and desired effect.

Throughout the formation of their individual maps, the discussion was ongoing and constant between all participants. Ideas were tossed back and forth as well as critique of each other's comments, leading to new nodes (causes) being added, although an unspoken etiquette meant that nobody wrote on or edited another person's map. The dialogue directed and funnelled the expansion of the maps down certain channels, with nodes added as the dialogue passed through and beyond that particular point. This interaction dynamic meant that causes (nodes) were discussed in a highly collaborative manner. The associations (links) between causes were added individually with little discussion, and while there was some collaborative comment on each other's maps, most of the commentary was on the actual concepts raised.

Although the activity had to be cut short due to time constraints, the dialogue had been so valued that there was agreement that the maps would be revisited for further discussion after the LAND workshop. Consequently, the maps of this CEO exemplar group, shown in figures #6.24, #6.25 and #6.26, are unfinished. This was typical for most participants across all workshop sites and is partly due to the nature of causal mapping that allows authors to continue to add to their maps over an extended period of time (Craig, 2000). In many cases individuals were concerned

that their map not be lost when taken away for copying because they wanted to add to it later in their own time.

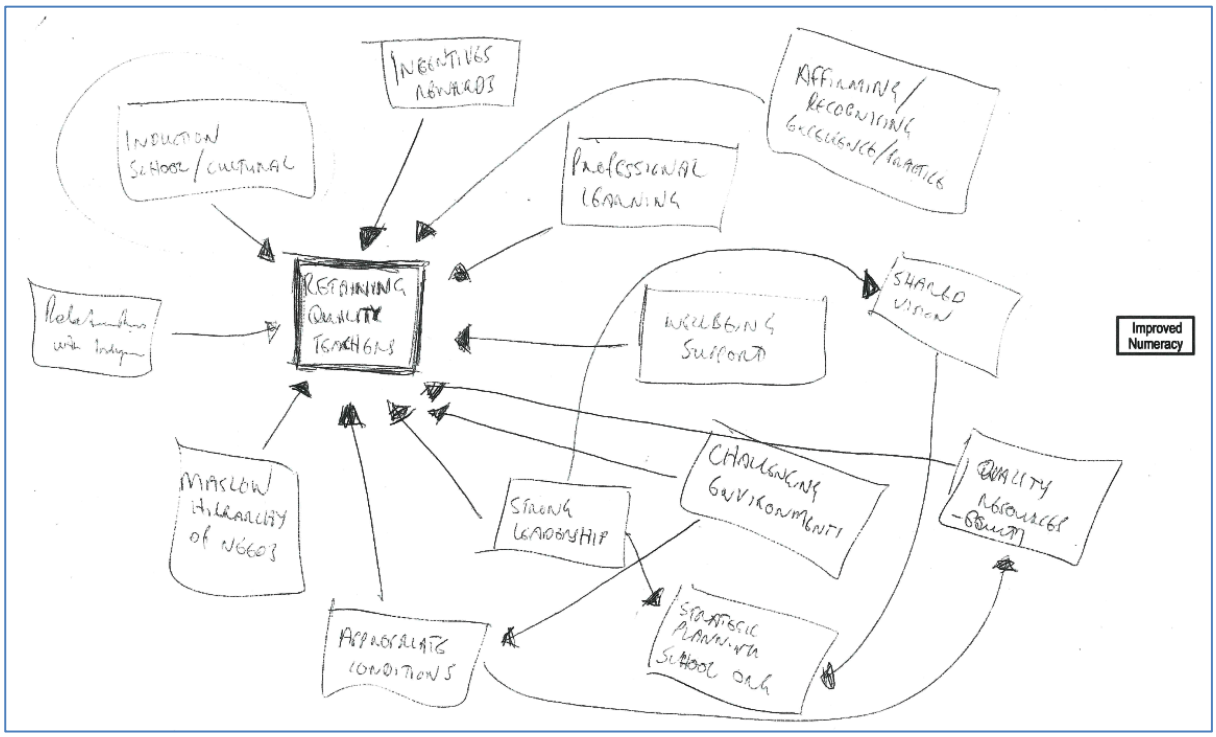


**Figure 6.24 CEO-1**

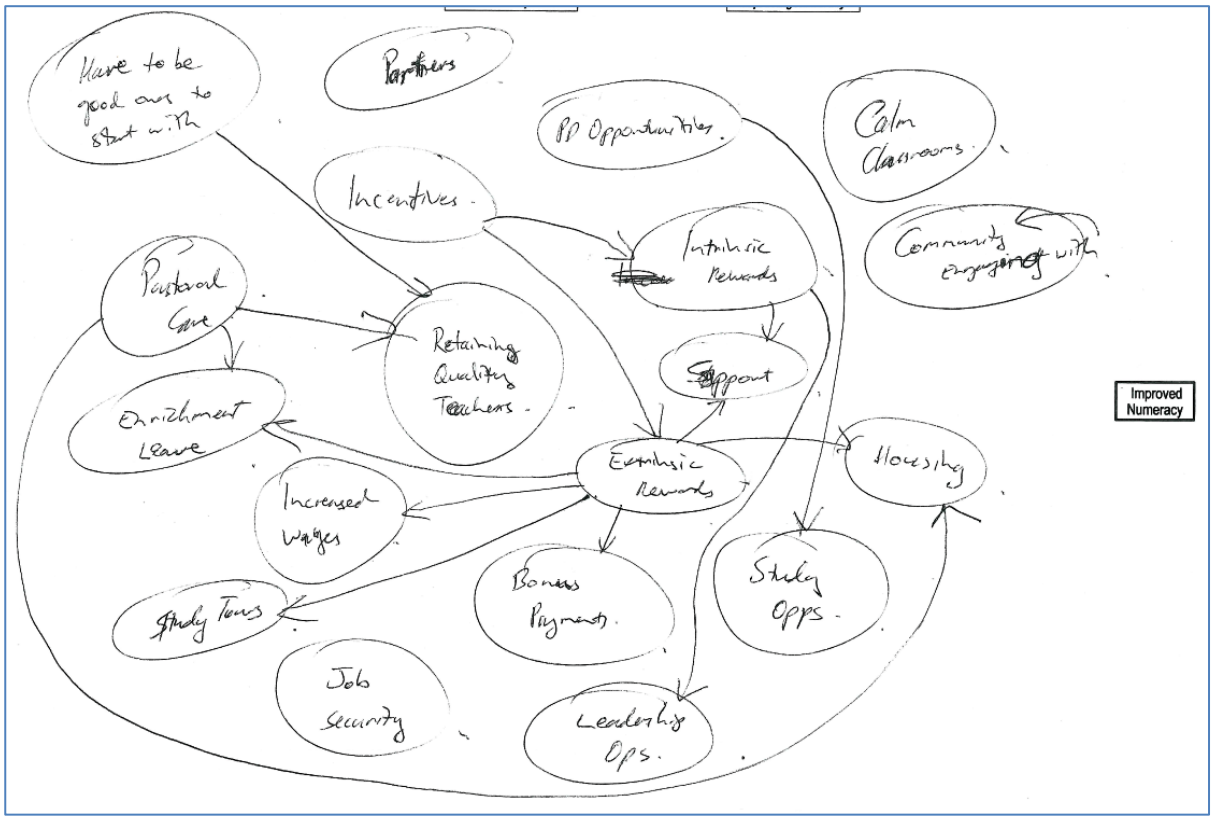


**Figure 6.25 CEO-2**

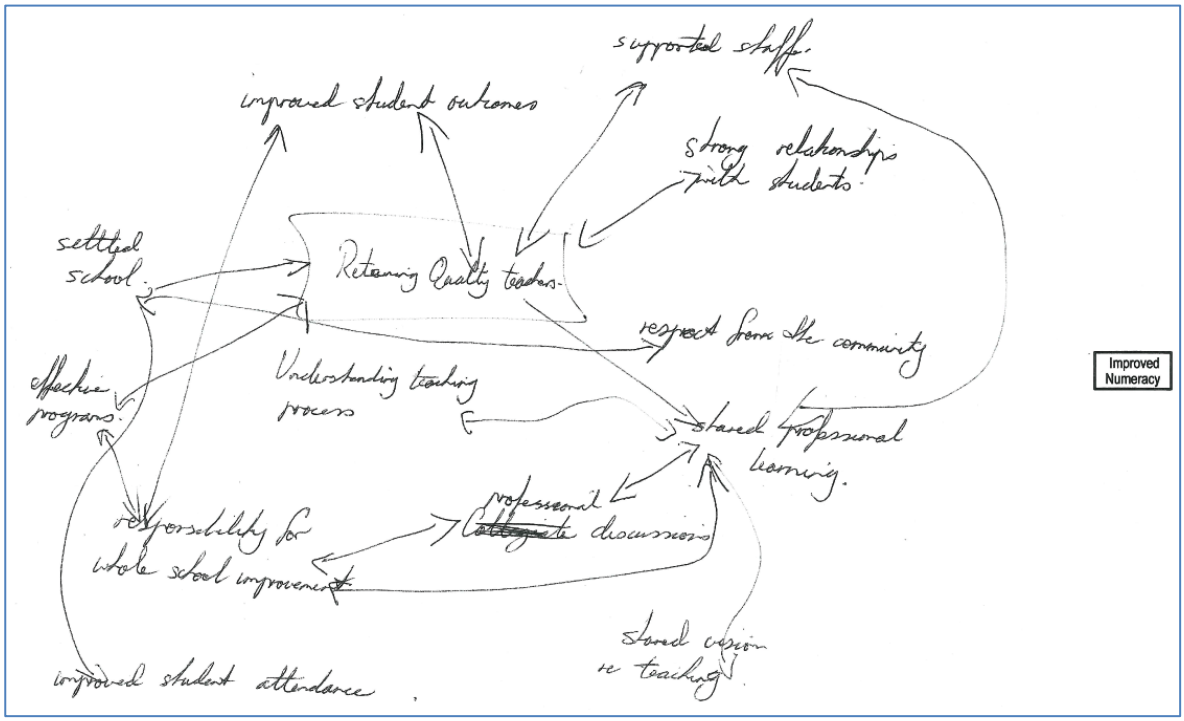


**Figure 6.26 CEO-3**

The differences in the approach to and style of mapping are worthy of comment. First, while a specific method of causal mapping had been introduced prior to this activity and all group members agreed that they understood what was required, only one person used bubbles for nodes and arrowed lines for links in the agreed fashion. The other two used either square boxes or no boundaries on their nodes, and non-directional lines. It is not clear whether this ignoring of the rules affected the conceptual outcome of the maps, but authors such as Novak & Cañas (2006) consider that the elements of a causal map, particularly the boundary bubbles around the nodes, promote a particular way of thinking. This notwithstanding, some of the common features seen in these maps may be partly the result of these idiosyncratic mapping styles.

Second, there are a number of common features among the maps:

- None of the links have any explanatory text
- None of the maps actually link the chosen cause to improved numeracy
- Most of the nodes connect directly to the starting cause

These features might also be explained by the lack of familiarity with collaborative, strategic discussion. As tacit concepts became explicit they were added as nodes to the maps, but how one cause related to another remained tacit and was not directly addressed. As the facilitator, I asked a number of times how node 'x' led to node 'y' but the question went unanswered, being lost in the ongoing discussion of specific causes and their 'obvious' links. The focus was kept on the initial cause, which acted as a type of brainstorming base that kicked up related and immediate other causes.

The absence of linking to 'improved numeracy' (which was the whole point of the project), was common to many of the individual maps. Participants found it difficult to identify causal links that would connect their original cause with the final desired effect of improving numeracy. I frequently asked people how what they had drawn linked to the box on the right side of the page. The response was frequently to draw a line from where they were straight to improved numeracy, or to say that they 'had not got to that bit yet'.

Some possible explanations emerge from observation of these discussions. First, participants' understanding was being constructed during the dialogue, with ideas initially placed as nodes and then discussed. This made explicit specific causal concepts which were then added to and expanded. An analogy would be to consider the initial tacit contribution to the maps as being in black and white turning to full colour as meaning is made explicit and new knowledge is created. The maps could therefore be considered to be in transition from 'black and white' to 'colour' as time went on and the focus shifted to a new part for elucidation. The maps tended to colourise from left to right, as participants worked on filling out the causal network in the available time.

A second potential factor was that the complexity of the causal connections and the physical limitations of the A3 paper militated against making connections. Most people quickly filled the left hand space, making a number of nodes and links, with

the gradually filling page not leaving enough room for a step-by-step link all the way to improved numeracy.

The maps of the CEO staff in this exemplar group also act as exemplars in their density and pattern of links. A number of nodes were common to the maps due to the dialogue, but the links between nodes differed, being drawn individually without as much discussion. This allowed the interests and contextual concerns of each person to emerge. The densest secondary node for CNT-2 is extrinsic rewards, for CNT-3 shared professional learning and for CNT-1 strong leadership. Thus three quite different focal causes, all linked directly to retaining quality teachers, emerged from the one discussion and the same starting point.

'What incentives would keep quality teachers in remote schools?' was an ongoing topic of conversation with CNT-2, reflecting the passion and concern this person had with this particular issue. The same can be said for each of the topics related to the dense nodes for the other two. Thus their maps reflected the interest, focus and level of thinking on topics of high priority for them, moving from the common starting point to these areas of interest.

Using the Niche framework a few more observations can be made on the mapping process of this exemplar group. The dialogue revolved around two of the three loops in the framework. The 'churn' of staff was seen a contextual issue related to the instabilities and constraints within their environment. The cause chosen by this group, retaining quality teachers, was prominent in their particular context and provided a common starting point for looking at the problem. Finding and retaining quality staff was also perceived as an intractable people problem, and therefore, not surprisingly, most of the other related causes added to the maps were people-related. In contrast, little of the discussion addressed system issues relating to the complexity or ambiguity of trying to retain teachers in their particular

circumstances. Any questions I asked as facilitator around these dimensions were deflected or ignored.

Thus this group can be said to have effectively used the maps as boundary objects for increasing their shared understanding of four of the six dimensions of wickedity related to improving numeracy. Ignoring the system dimensions allowed the problem to be tamed to the extent that the group was pleased that their final result was manageable and somewhat solvable.

This group provided an exemplar of an interaction dynamic of collaboration-individual-collaboration, with a lack of previous collaborative history. The group in the next section provide an almost opposite profile, with a long and highly developed culture of collaboration.

#### *6.3.3.2 Team collaboration history exemplar 2 (Ind-Ind-Col)*

The different collaborative cultures of the CEO groups were significant, and impacted on the causal mapping process. For the participants described in the previous section the opportunity to engage in collaborative strategic thinking was new, enlightening and invigorating for them. The newness and value of the interaction showed in their expressed desire to do it more often, but also meant that time had to be spent by the facilitator on explaining the process and the underlying thinking, and then facilitating the dialogue.

In contrast, the participants from another CEO group were completely unfazed by the concept of mapping or of collaborative strategic thinking. Everybody immediately set to work and required little facilitation or explanation. Although maps were worked on individually, there was a constant dialogue about the concepts and ideas being addressed.

I checked to see if causal mapping was a commonly used tool but was told, "No, it's just that we do this sort of thing all the time". One member later explained that there had been a couple of years' intensive work to build a strategic and collaborative approach to tackling issues. Consequently the new mapping process was easily adopted as another useful tool for an ongoing organisational dynamic.

Most of the maps from this group were similar to those from other groups, but the dialogue was different, being of a higher level and more critical and strategic. This is evident in the map shown in figure #6.27. It is one of the most sophisticated maps created during this activity from all of the groups. The concepts in each node are high level and represent key causes. The complexity and density are not high but the author weaves three causal threads into one integrated map. The box left of centre, containing 'increased knowledge', 'critical lens' and 'reflection on current practice', acts as a key node through which each path passes.

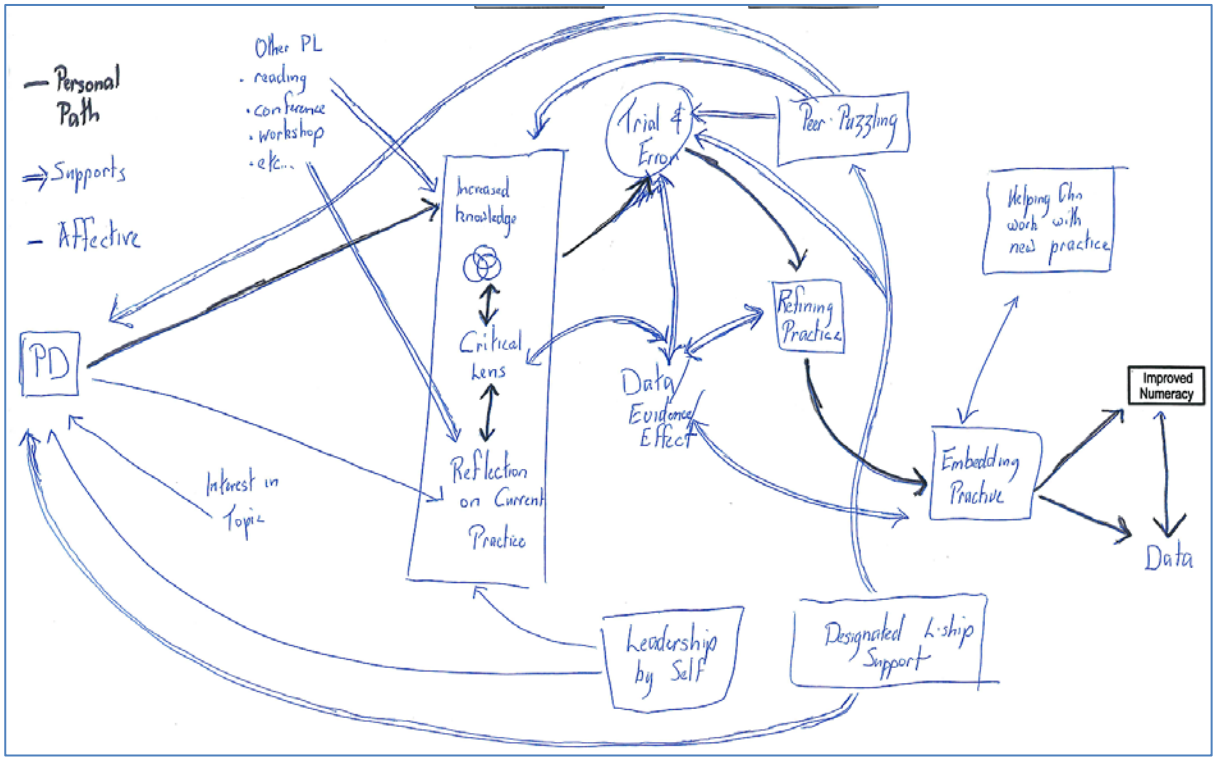


**Figure 6.27 Example of a sophisticated causal map**

### 6.3.3.3 Individual map construction, peer editing exemplar (Ind-Ind-Col)

Figure 6.28 provides an example of the map development dynamic in accordance with the instructions (Ind-Ind-Col), but with ongoing dialogue, chatting and joking throughout the activity.

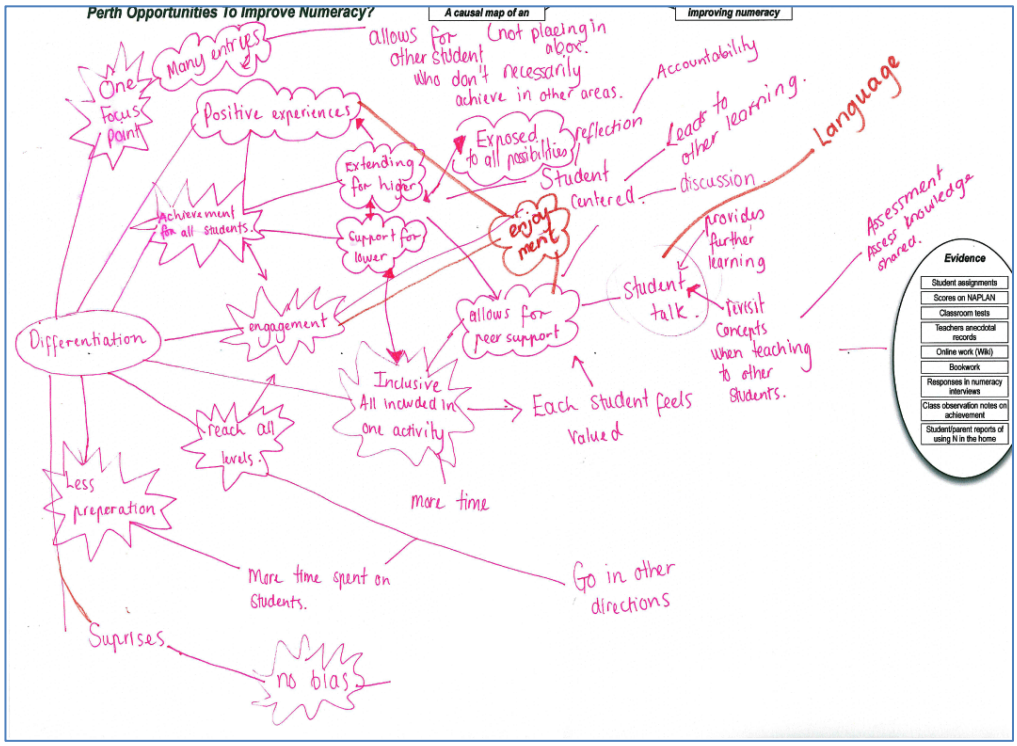


**Figure 6.28 Example of ACF dynamic with ongoing chatting for individual map**

The author was one of a school group of three, who were collaborative and talkative. The way they interacted during the workshop, they informed me, was the way they tended to interact in their school setting. The author used the pink pen for the original mapping, and the red for additions during the editing conversation.

The editing conversation was systematic, respectful and detailed, functioning primarily as a form of check on the author's thinking. Only a few new ideas were discussed, agreed on and added to the map. The photo shown in figure #6.29 is taken from the video footage of this editing process and shows the use of the physical map functioning as a boundary object. Both participants are pointing to

places on the map during their discussion. This kept the focus of the discussion on the concepts in the shared visual space and not on the person speaking. The maps also provided a visible and stable place for ideas to be debated so that there was little repetition of arguments in the dialogue.

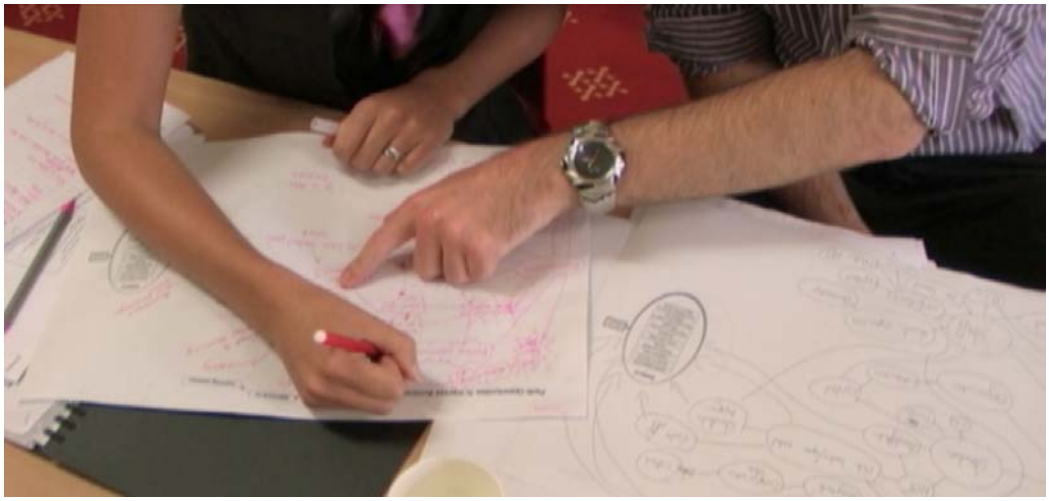

Figure 6.29 Example of collaborative editing of individual map

#### 6.3.3.4 Individual map construction, individual editing exemplar (Ind-Ind-Ind)

Some groups decided that individual work at all stages of the mapping process (Ind-Ind-Ind) would be a more effective use of time. The map shown in Figure #6.30 is a good example of the output from this type of collaboration. This school group of four swapped their maps a number of times, with little discussion. The example here shows the blue pen of the original author, followed by a black edit by a second teacher and then red edit by a different teacher again. Each edit placed additional nodes and links on the map with no crossing out or deleting of previous notation. In this way the map quickly increased in both the number of causes and causal links.

This process was an effective use of time and made possible because of the high level of trust and history of collaboration between the group members. When queried about the process they chose, the response was "we are used to working together and building on each other's ideas." This has implications for those embarking on a

new effort to tackle a wicked problem. Current, successful collaborative work practices will provide a good foundation for attempts on new problems.

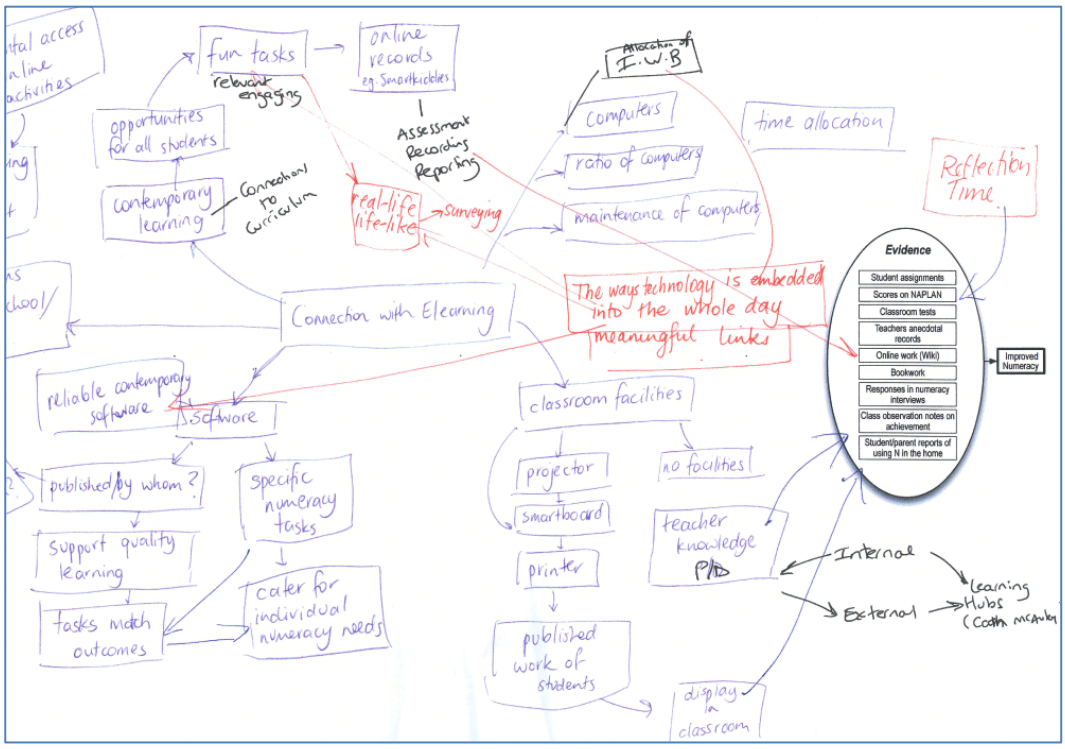


**Figure 6.30 Example of individual work throughout the mapping process**

### *6.3.3.5 Individual map construction, no collaboration dynamic (Ind-Ind)*

The map in figure #6.31 is the result of a highly individualistic dynamic (Ind-Ind). The map was drawn by a school principal who was interested in clarifying his own thinking and did not include the other members of the school team in any discussion. The difference in pen colour was only to denote his own main concepts. Following some questioning from myself as facilitator, the participant expressed satisfaction in the mapping process as a means of brainstorming ideas and laying information out in a systematic way. Notes on the map also denote some of the questions that arose during our discussion. What is missing are any questions or ideas about collaboration or concepts from any of the other team members. Further observation made it clear that this was consistent with the group dynamic that functioned within this group's school-work environment.

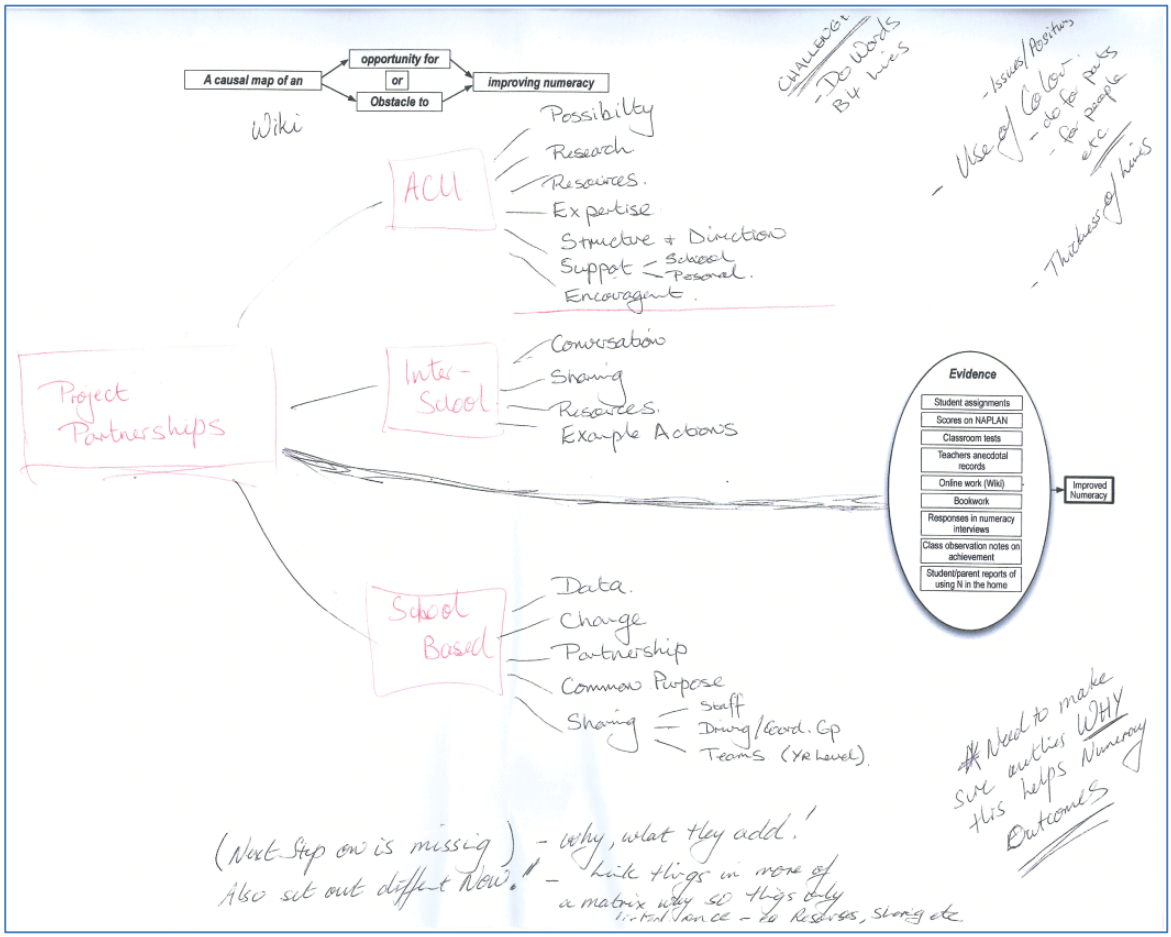


**Figure 6.31 Example of individual work with no real collaboration or editing.**

During the final workshop this principal was unable to participate in the collaborative mapping activity and the other team members expressed concern that they could not continue because of this. After reassurance from the facilitator that it was "OK to give it a go", these team members engaged in a highly collaborative dialogue that resulted in the map shown in Figure #6.32. Although not complex, the map links multiple causes and provides descriptive text on the links, expanding on the information given in the original map and increasing their shared understanding of the problem. This demonstrates that these participants were capable of engaging in constructive collaborative dialogue and using causal mapping as a boundary object to improve their shared understanding of the problem. Their earlier

expressed feelings of inadequacy appear to be directly linked to their work relationship dynamic with their principal and not related to their capacity to tackle the wicked problem before them.

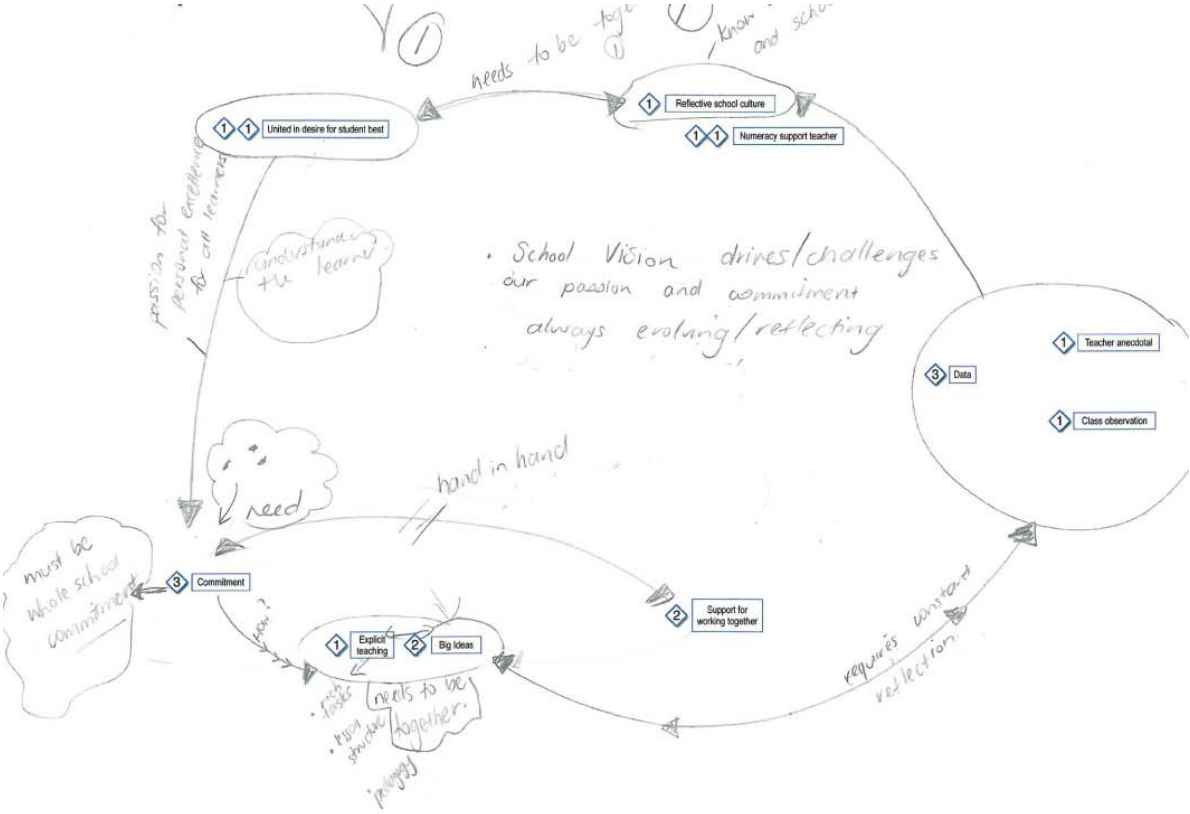


**Figure 6.32 Other team members collaboratively produced map in final workshop**

### *6.3.3.6 Linked causal map as an artefact of collaborative decision making*

The LAND final workshop activity of linking the top three causes also provides insight into how the collaborative history and dynamics of participant groups were reflected in the map-making process. During the workshop one group ignored the provided map and instructions. Instead they created a new map (shown in Figure #6.33), that represented a summary of what they believed were the core issues. This was not an arbitrary rebellion (they asked permission after I commented), but

rather a desire by the group to best represent their thinking, which they believed had moved on from the earlier workshops and the map they had then produced.

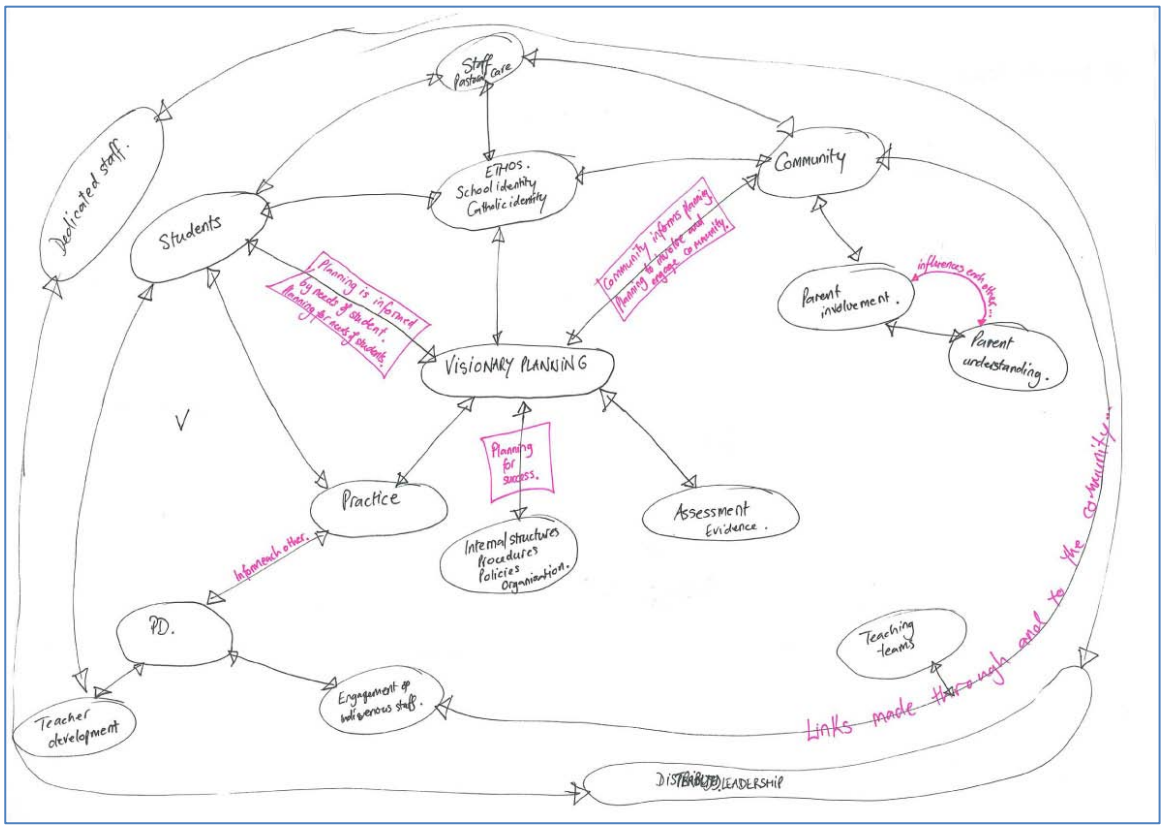


**Figure 6.33 Response that deliberately ignored all parameters given in the activity instructions**

### *6.3.3.7 The map making process: conclusion*

In summary, the construction of individual maps displayed a range of different characteristics related to stakeholder thinking, collaboration history and the process of dialogue. While a few participants struggled to draw any sort of map, creating lists of causes instead, most of the participants developed their own maps, collaborating at some stage during the development of causes (nodes), associations (links) and editing. The differences in these interaction dynamics have been shown through various exemplars, which have highlighted some of the consequences of each type of interaction. Thus the mapping process could be said to supplement, develop, amplify or encourage collaboration depending on the group's prior history.

This overview of the map-making process provides a foundation and context for the discussion of the role of causal mapping as a boundary object and in addressing four dialogical learning mechanisms (Akkerman & Bakker, 2011, p. 151), which are the focus of the next section in this chapter.

### 6.3.4 Four dialogical learning mechanisms related to causal mapping as a boundary object

Causal maps were used in this study as boundary objects (Akkerman & Bakker, 2011), with the intention of providing a shared visual space for collaboration and dialogue, resulting in an increased shared understanding of the wicked problem of trying to improve numeracy achievement in low SES schools. The original questions for this second research thread, focusing on the causal mapping process, are based on four dialogical learning mechanisms (Akkerman & Bakker, 2011, p. 151) that are a function of boundary objects. These are identification, coordination, reflection and transformation. The following discussion addresses each of these in turn.

#### *6.3.4.1 Identification*

**Is there evidence of an increase in awareness of their own and other frames of meaning?**

For the great majority of participants, causal maps did act as boundary objects in promoting 'identification'. Although there is no record from the observations of any participants using the term 'frame of meaning', there are quite a number of observations where the concept was clearly displayed. For example, the NT CEO group members expressed a growing awareness of their 'position' and how it differed or not from the others. This was the same to varying degrees in all the groups. Some groups, such as the WA CEO, had been working together for a long

time and had deliberately worked on becoming more aware of each other's 'perspectives' and 'logic', as was explained to me after one session.

Very few people seemed immune to this particular function of the maps as boundary objects. These did not enter into genuine dialogue, tending to present their own viewpoint that allowed for no disagreement. Consequently, there was not any raising of awareness of either their own or other peoples frames of meaning during the mapping activities.

### *6.3.4.2 Coordination*

**Is there evidence that the process facilitated conversation and grounding? (Kraut, et al., 2002, p. 33)**

The causal mapping workshop activities were full of spirited and relevant conversations. Participants regularly referred to the elements of the maps, pointing, touching and drawing on them as they conversed. The mapping process, combined with the focus questions, encouraged a dialogue that brought tacit meanings to the surface and linked theoretical concepts to specific school issues. A number of people expressed their appreciation of the mapping process as a way of facilitating their conversation while keeping it focused. One group from the SA schools cluster adopted a mapping approach to their school planning for just this reason. Therefore the causal maps functioned well as boundary objects in relation to coordination as a dialogical learning mechanism.

### *6.3.4.3 Reflection*

#### Is there evidence of tacit understanding being made explicit?

The dialogue that occurred in all the sessions was full of tacit understandings being drawn to the surface and not only made explicit but also more fully constructed. This was backed up by observation of the discussions during the workshops. The small groups worked through each of the categories, evaluating, discarding and then adding detail to the maps. This process enabled participants' initial tacit thinking to be made explicit, as well as build on their original ideas through the process of collaborative dialogue.

#### Is there evidence of increases in participant understanding (as shown in their maps) of complexity and consideration of alternatives.

In almost all cases the number of causes and links on the maps increased in each of these dimensions. While for some this was the general accumulation of more information and a filling out of the various aspects of the problem, for most participants the mapping process was a profound activity that provided them with new strategic insights into the breadth and depth of the wicked problem facing them.

### *6.3.4.4 Transformation*

#### Is there evidence of increased understanding and constructing of meaning with individuals and groups of participants?

Comparison of the initial maps (created from the survey information) with the revised maps (resulting from the workshops) shows a significant increase in the understanding of the mix of causes required to improve numeracy achievement in these low SES schools. Using the LAND model as a guide, whole areas of the model that had been neglected on the initial maps were introduced to the revised maps, as well as filling out areas already containing some causes.

Groups again ranged in how much they added to their understanding both individually and corporately.

### Is there evidence of the process encouraging an analysis of critical relationships in a system?

The final activity of workshop #4 required participants to make links between various causes and to describe the nature of those links. Many of the groups described these maps as about 'the whole system' or the 'important bits of the education system'. The use of 'system' here aligns with two of the definitions provided by the Australian Macquarie dictionary (Delbridge, 2005):

I. An assemblage or combination of things or parts forming a complex or unitary whole.

II. At a colloquial level, society at large or an organisation within it.

Each group analysed these 'systems' of causes and links to identify the critical relationships. The maps encouraged this approach, with almost everybody identifying the critical elements of the system from their own point of view and then analysing how those elements worked together. For example, a group from the final WA workshop said that this particular activity had made them aware that the critical elements in their system had changed over the course of the LAND project. By addressing some underlying causes as a priority they were now ready to move onto different parts of the system.

## 6.4 Chapter Summary

This chapter has presented the findings from the large collection of data gathered in multiple ways so as to answer the first two threads of research questions. The findings support the claim that the problem in this study is 'wicked' and that the stakeholders involved in this wicked problem view the underlying causes of the problem in quite different ways.

The differences in thinking have been shown relate to the knowledge cultures that stakeholders belong to as well as the specific contexts they work within. Each group demonstrates its own individual profile in how they see the underlying causes fitting together and being prioritised, with the schools and CEO groups showing the most alignment.

These findings now provide a foundation to test the value of the Niche wicked problem framework and this is the focus of the next chapter.

# 7 Applying the Niche Framework

## 7.1 Introduction

This chapter provides an opportunity to test the Niche Wicked Problem Framework (hereafter referred to as the Niche framework) by applying it to the findings outlined in Chapter #6. The stance taken in this study is that wicked problems need to be treated differently from tame problems in order to tackle them successfully. They require a framework specifically designed to tackle the characteristics of the wickedness of the problem.

The framework, presented in Chapter #4, consists of six dimensions, grouped in three loops, as shown in figure #7.1. These dimensions reflect the characteristics of wicked problems in accordance with the literature and my work experience as a consultant over the past 15 years.

People (Blue)

- Diversity
- Intractability

Systems (Green)

- Complexity
- Ambiguity

Context (Red)

- Instability
- Constraints


Figure 7.1 The Niche Wicked Problem Framework

The value of such a framework was seen in terms of the manner and extent to which it supported the enhancement of a shared understanding and construction of meaning between individuals and groups, and the analysis of critical relationships in public policy systems (Narayanan & Armstrong, 2005, p. 2). The nature of wicked problems means that stakeholders need to gain a picture of 'the whole' in order for any positive action to take place. The ambiguity of wicked problems requires that stakeholders understand the various meanings of key terms and concepts. Therefore this study was designed to investigate the extent to which the Niche Framework:

1) is both comprehensive and coherent in capturing the range of stakeholder thinking and actions on wicked problems

2) can be used to explain research findings about wicked problems

3) provides support in diagnosing and tackling wicked problems (Narayanan & Armstrong, 2005, p. 3)

To this end, a series of themes and related questions were presented in Chapter #1 and are summarized here in Table #7.1. The structure of this chapter follows these themes, utilizing the findings from Chapter #6 to illustrate the points made in response to the related questions.

***Table 7.1 Framework themes and questions***

| Themes | Related Questions |
|---|---|
| Explanatory Value | Does the use of the framework<br>• provide a straightforward, comprehensive and coherent way of making sense of the range of stakeholder thinking about wicked problems?<br>• add explanatory value to the findings already identified? |

| | |
|---|---|
| | • clarify issues raised in the literature? |
| Making Sense of Symptoms | • Does use of the framework help to explain the symptomatic responses of stakeholders to the problem? |
| Identify Taming or Tackling Behaviours | • Do participants attempt to tame the problem along one or more of the dimensions of the framework and if so how and why? |
| Policy | • Can use of the framework inform policy development, implementation and evaluation? If so, how? |

The Niche framework can be used to provide a comprehensive and coherent way of making sense of the diverse findings from this study. It can also be used to clarify the issues raised in the literature about wicked problems.

Participants' symptomatic responses to the wicked problem were expressed as concerns and emotional reactions during the LAND project workshops, school visits and in individual discussions. Each dimension of the Niche framework can be identified in these responses, with a related set of symptoms dominating in each of the three main areas of people, systems and context.

A key element in the literature is that most people attempt to solve a wicked problem by 'taming' it rather than 'tackling' it. This was shown in the responses from participants, with most trying to tame the problem through ignoring or reducing it to one dimension. The Niche framework can be used to explain how this was done and why. Examples of this can be found in sections #7.4 and #7.5.

## 7.2 Explanatory Value

The nature of wicked problems means that stakeholders need to gain a worthwhile picture of 'the whole' for any positive action to take place. Therefore any process in tackling wicked problems must involve stakeholders clarifying and sharing their understandings. The Niche framework helps in this endeavor. Evidence of each dimension of the framework emerged in the findings and therefore the problem at the centre of this research has been demonstrated to be 'wicked' according to the characteristics listed in the literature. Further, the findings indicate that all of the dimensions interact in a dynamic way, which is another characteristic of wicked problems.

### 7.2.1 Comprehensive and coherent way of making sense of the range of stakeholder thinking about the wicked problem

The Niche framework allows the findings to be represented with a radar graph, shown in Figure #7.2, with each dimension assigned a value from 1 to 5 based on the comments from participants and the results of their maps. This is not a statistical representation but a simple 'information graphic' (Harris, 1996), i.e. a subjective diagrammatic statement of the relative levels for each dimension found in the findings in Chapter #6. The graph shows that for this particular problem, complexity was extremely high and well represented in many ways, (see Section #7.3.1). To a lesser extent, ambiguity, constraints and intractability were all also clearly represented, (see Sections #7.3.1-4). Diversity and instability had the least representation in the findings but both were still significant, (see Sections #7.3.2-3). Diversity would probably have been higher if participants had been drawn from the wider range of stakeholders actually involved with the problem. Instability was a significant factor for remote schools but not for the urban schools, which brings the level of instability down overall.

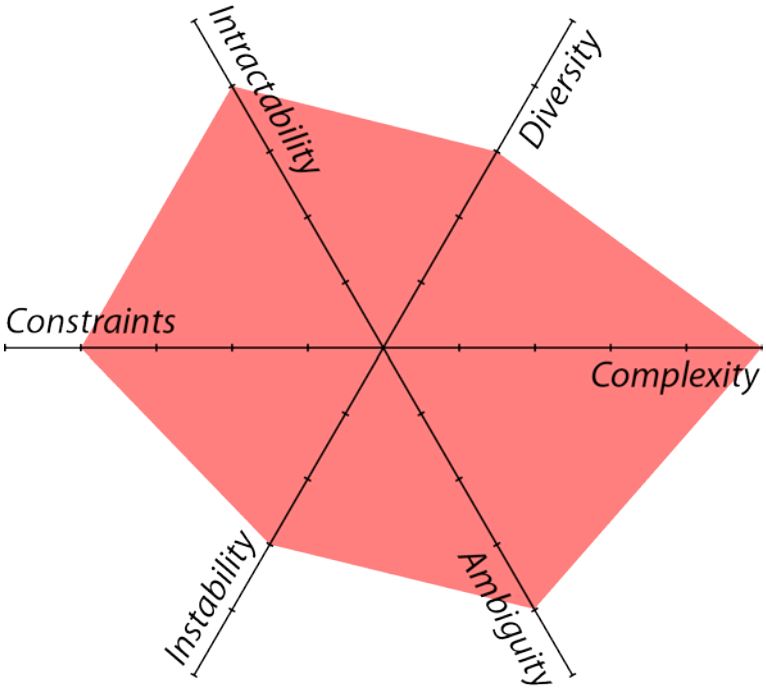


Figure 7.2 Research findings represented by radar graph

The information from this graph could be used to readily communicate to stakeholders the broad parameters of this particular wicked problem. The implications of the relative strength of each dimension could then be discussed to increase the shared understanding of stakeholders about the problem. Thus this single multidimensional representation of the problem can be used as a general description of the problem's multiple aspects. A more detailed description of the problem, as it is revealed by the framework, is given in the next section.

## 7.3 Explanatory Value Added To The Findings Already Identified

The Niche framework's six dimensions are grouped into three loops: people, systems and context. Many of the characteristics and issues raised in the literature are evident in the findings but the research process also brought other issues to the surface that add further texture to concepts raised in the literature. This section utilises the framework to see what additional explanatory value it can bring to the findings.

### 7.3.1 The Systems loop: Complexity and Ambiguity

Complexity and ambiguity both have a foundational function in the literature and show a similar role in the findings (Head, 2008a). The systems loop is focused on the dynamic relationship between inputs, processes and outputs. As stated in Chapter #4, the **complexity** of a problem is a systemic dimension and is affected by the number of systems involved, how they interact with each other, and how intricate the whole 'mess' (Ackoff, 1974; Ney, 2009) is (i.e. the number of links between different parts of each system and to other problems, the possible points for intervention, and the consequences of intervening).

**Ambiguity** as the second dimension in this loop interacts with and amplifies the complexity of the problem because multiple meanings and evaluations often exist for the same system and for interpreting terms, labels and consequences of action. The whole is perceived differently according to different groups.

The findings confirm that the problem under investigation displayed a high degree of both complexity and ambiguity at different levels of granularity. At a general level, the combined, near 700 identified causes attributed to the same problem shows a form of complexity based on sheer volume. Once stakeholders began to link these causes, the complexity increased. Stakeholders made sense of the complexity differently, contextualising causes using the knowledge cultures of which they are a part (V. Brown, 2008, p. 37). This multiplicity, inherent in the ambiguity of interpretation, was shown during the final workshop in the many different ways people linked the limited and fixed set of nodes on their maps.

Ambiguity is also foundational for wicked problems, as seen in that characteristics in the literature begin with the difficulty in defining or formulating a single view of such a problem. By asking what is required to improve numeracy, the research provided an insight into the way stakeholders define the problem, as well as what is required to tackle it. Initially, there appeared to be no disagreement on what the

general problem was. However, asking participants to explain what the elements of the problem were, how they related to each other, or what was required to 'fix' it, quickly dissolved any semblance of agreement. The many alternative interdependencies and the multi-causal nature of the problem provided as many ways of putting the problem together as there were stakeholders.

This lack of agreement on the nature of the problem itself is a contributing factor to the differences in meaning the participants attributed to key terms (e.g. 'system') as discussed later in this section. This ambiguity occurred in a number of ways, all of which made an agreed definition on what constitutes the elements of the problem impossible. This situation naturally flowed on to disagreement on what is required to tackle the problem.

Ambiguity is also evident in the difference between the stakeholders in both the 'granularity' and focus of their listed causes. Their responses ranged from a very general and coarse-grained approach down to a highly contextual and fine-grained detail. These differences broadly corresponded to the level of system to which participants belonged. Those from DEEWR provided the broadest causes, using general terms such as amalgam of factors and drivers in change. In contrast, teachers picked specific causes for the problem in their particular school such as the need for class resource boxes.

The range in focus was similar, from a broad 'brush stroke' approach that considered multiple causes as important through to a tight focus on specific collections of causes in a particular combination. There was also little agreement on the starting point for what causes the problem or on what the finishing point should be.

A result of all these factors is the difficulty of trying to agree on a 'solution' to a wicked problem. Here ambiguity reigns supreme. The APSC (2007) claims that

"there is no clear and correct solution", which is put more paradigmatically by Rittel (1973) as, "solutions are not right or wrong but good or bad in the eyes of the stakeholders" and Horn (2007) as, "multiple value conflicts" and "different views of the problem" lead to "contradictory solutions". The school presentations in the final workshops all demonstrated a logic for 'fixing' or 'improving' the wicked problem of low numeracy achievement of their students. Each presentation focused on different causes as essential for their solution.

Finally, there is the ambiguity in the use of specific terms and labels. Some words are more inherently ambiguous, and a number of these were central to the thinking of particular groups. For example, System appears in different subcategories in each of the categories of **VISION**, **TEACHING**, **ORGANISATION**, **SCHOOL** and **OTHER**. It appears a total of 11 times, 5 from schools, 4 CEOs and 2 from DEEWR. Of the 14 different definitions for 'system' provided by the Australian Macquarie dictionary (Delbridge, 2005), the following three cover most of the ways participants used the term, as well as how it is used in the wicked problem literature:

- An assemblage or combination of things or parts forming a complex or unitary whole.
- An ordered and comprehensive assemblage of facts, principles, doctrines, or the like in a particular field of thought.
- At a colloquial level, society at large or an organisation within it.

Observations during the workshops showed this final definition to be the most common way that participants used this term, but all three were used at different times. In a number of cases small group discussions began to come closer to one of the first two definitions above. The best example of this can be seen in the revised Northern Territory CEO map, where four levels of 'system' have been inserted between the **ORGANISATION** bubble and the **EVIDENCE** bubble. These levels are 'class', 'school', 'CEO' and 'government'. This addition to the map came after a

protracted and sophisticated discussion on these different levels of the education system. Concern was expressed that at each level, issues of organisation and the types of evidence required to improve numeracy would be different.

### 7.3.2 The People loop: Diversity and Intractability

The 'people' loop is about the individuals, groups and organisations involved in wicked problem, and includes the dimensions of diversity and intractability. These two dimensions are critical for establishing that a problem is not just a highly complex 'normal' problem but is actually a different category of problem and can be considered 'wicked'. The lists of characteristics in the literature all identify diversity and intractability in various ways. Even though all the participants for this study were directly involved in working in education the findings still demonstrate alignment with the literature for both dimensions in this loop.

**Diversity** is an expression of the differences between stakeholders (Head, 2008b). These differences may be individual but often reflect different ways people form more or less coherent groups. These groupings can also be expressed as different types of knowledge cultures as defined by Brown et al. (2010).

The differences in the causal maps produced by the participants seem to be related to the specific contexts in which they are working. This would mean that the 'local knowledge cultures' dominated the thinking of participants in this research (V. Brown, et al., 2010). At the school level the focus for each school appears to be based on specific issues that are currently being faced. For example, attendance is one of the few causes listed by four different groups, identified as a problem by both the NT remote and the WA remote school clusters.

Diversity, in the sense of difference in focus was more noticeable between the different layers of the education system. The LAND framework maps listing the top

three causes for schools, the CEO and government, showed clear differences in priorities. Three of the four school clusters listed causes in the **OUTCOME** bubble, with priorities ranging from 1 to 3. Specific causes included four counts of evidence, data, and observation. In comparison, only one cause, data, ranked 4th, was placed in the **OUTCOME** bubble for the CEOs or government

The other dimension in the people loop is **intractability**. This dimension is focused on resistance to change by individuals, groups, and organisations. This resistance may be in the adherence to specific beliefs by an individual or the difficulty of changing institutional and structural elements of an organisation.

The findings demonstrate a number of areas of intractability and responses to it. In relation to individuals, study participants considered the attitudes of certain stakeholders to be intractable. For example, members of the NT school cluster identified parents in this way. In discussion, the view was expressed that this parental resistance was a cultural issue and not open to being challenged.

At an organisational level the problems of staff recruitment and turnover in remote areas was raised by a number of groups, particularly the NT school cluster. The view expressed here was that this situation was a 'given' or 'just a fact of life', the natural consequence of remote schooling. This is an example of an intractable issue also functioning as a constraint, and will be revisited in Section #7.3.3.

For teachers, government policy and directives, including NAPLAN, were also seen as resistant to change. The response from many was 'we just have to live with it'. In contrast to other forms of intractability, school clusters engaged directly with NAPLAN, incorporating it in their projects. This engagement led to a recognition of the potential usefulness of this government initiative while still disagreeing with its overall value for education.

Some aspects of the wicked problem that were seen as intractable were so broad that they could fit just as well in the context loop and will be addressed in the next section.

### 7.3.3 The Context loop: Instability & Constraints

The context loop includes the constraints and instability dimensions. These dimensions are represented in the findings and support the claim that this is indeed a wicked problem. Both these dimensions are primarily concerned with the environment within which the problem occurs.

**Instability** relates to the unstable and evolving nature of wicked problems. The problem is not static, but changes over time, so that any attempts to tackle it must deal with a dynamic situation. This is particularly important in setting policy, as measures implemented may be applied to a different situation from the one that existed when the policy was designed.

The most obvious example of instability discussed by participants was the transience of staff (already identified as an example of intractability). Another area of instability noted was the constant policy changes at school, state and federal levels. All participant groups identified this as an issue that had to be dealt with regularly. These changes were viewed negatively by teachers as disruptive and unnecessary, and more to do with administration and politics than learning and teaching. In contrast, DEEWR personnel considered policy change as essential to school improvement. By the final workshop all the schools acknowledged that their school environment had changed over the course of the two years of the project and that any initiatives implemented to sustain improvement of numeracy would need to take these changes into account. Even as their environment was changing

participants noted that they were constantly confronted with a variety of constraints.

Participants noted multiple, interconnected **constraints** leading to symptoms of frustration and powerlessness. A number of constraints discussed by participants, aligned with those identified in the literature (Horn & Weber, 2007).

- **Financial:** This was noted at all levels and by all groups
- **Political:** Primarily meaning federal or state government policies or initiatives, but sometimes referring to school or CEO politics.
- **Cultural:** This was evident, and expressed, in different ways for each group. For the schools, their students' family culture and community had a direct impact on the issue of low numeracy achievement, which was in line with research on the relationship between poverty and poor school achievement (Guo & Mullan Harris, 2000; Hine, Jayme Montiel, Cooksey, & Lewko, 2005). The urban schools also had to deal with multiple cultures, and the associated 'English as a second language' issues. In contrast, the remote indigenous schools had more homogenous community cultures, but the gap between indigenous community and western school cultures was significant.
- **Problem solvers out of contact with the problems and potential solutions:** Each group of the participants expressed feeling distanced from some part of the problem.
- **Problem connected to other problems:** During the mapping activities most groups linked numeracy achievement to other major issues. For example, for the remote schools the problem of indigenous health and nutrition was seen as directly related to educational achievement. Also, issues around multiculturalism were raised by the urban school clusters which all have high levels of English as a second language (ESL) students .

A number of other significant constraints, not listed in the literature, were noted by participants including:

- **Time:** This was identified as a significant issue for most of the participants (and in my experience with most of my clients). Wicked problems by their very nature require a lot of time to tackle.
- **Systems and policy:** Schools are highly regulated places with strong boundaries placed on teacher action through numerous policies. School cluster groups expressed the desire to have the freedom to respond to the particular needs of their school context, rather than attempt to apply a generic policy they saw as inappropriate to their setting.

Toward the end of the project, when discussing how to build on the progress seen during the LAND project and create a sustainable future, these examples of instability and constraint came to the fore.

The dimensions of the framework do not just stand alone and disconnected from each other. Participants did not describe the issues in terms of a single dimension, but told interwoven and complex stories. Therefore, how the framework functions as a whole will be described next.

### 7.3.4 The framework as a whole

The model used to present the Niche framework uses the seamless Gordian knot to illustrate the dynamic relationship of each dimension with the others. This interaction is both between the dimensions within a single loop and between the three loops. The findings support this sense of interconnectedness as participants made connections between the parts of the problem in different ways.

The dimensions in the 'systems' and 'people' loops amplify the wickedity of each other. The difference in frames of stakeholder groups increases the complexity of the problem and any proposed solutions by multiplying the way the problem can be viewed. Different groups also had different interpretations of crucial ideas, labels and meanings, making any inherent ambiguity greater. This ambiguity at times increased the intractability of stakeholder positions as each group used their own frame to justify their position.

The interactions of the 'context' and 'systems' loops are primarily about the 'things' involved in the problem. The complexity is that much harder to tackle if the context is unstable and constantly changing. As an example, a number of participants joined the LAND project in the second year and struggled to catch up with the others on their team who had already had a year to tackle the complexities of the problem. The need to induct these new team members added another layer of complexity to the project team's workload.

Trying to get some shared understanding between stakeholders is made more difficult if the problem keeps changing or the factors involved are unstable. During the final workshops, a number of groups stated that the causes they had identified as the most important during the early part of the project were no longer as significant. The situation had changed and different issues had emerged that placed other causes as a higher priority.

The various types of constraints reduce the options for tackling the problem holistically and many of the constraints are exacerbated by the ambiguity of the issues involved. Using NAPLAN as an example, school groups wanted to explore the range of options for gathering evidence of numeracy achievement but were constrained by the prominence and time requirements of one type of testing, NAPLAN. In some of the final presentations alternative evidence of numeracy

improvement was shown that was not evident in NAPLAN results, but concern was expressed that trying to explain this to parents could be confusing.

The diversity of the 'people' loop impacts on the issues related to the 'context' loop. Constraints for one set of people may not matter or be perceived the same way for other groups of stakeholders. The different sets of causes listed on the maps of the different stakeholder groups is a case in point. Policy is also a good example; a pointless restriction for one group was an essential tool for improvement for another.

## 7.4 Making Sense Of Symptoms

Chapter #3 outlined my experience of wicked problems as a consultant, in particular the response from most clients of stress symptoms rather than characteristics of problems. Consequently it is reasonable to ask if the Niche framework can shed light on the symptomatic responses of the participants

Participants live each day with the consequences of the low numeracy achievement of students in these selected schools. Those from the school clusters are on the front line, face-to-face with the specific day-to-day details of life in school. The members of the CEO visit numerous schools and are able to see the differences between schools in their state or territory. Finally, the people at DEEWR are not directly involved with the schools but work with the policy issues that impact on the problem every day.

Each of these groups expressed significant symptomatic responses to the problem during the research. For some the problem was just too overwhelming and confusing. Other symptoms expressed were frustration, anger, fear, anxiety and

exhaustion. One school visit turned into a type of group counselling session as the combination of school workload and the totality of the wicked problem had become too much for the team. It was apparent that these symptoms needed to be addressed in order to help those stakeholders tackle the problem of low numeracy achievement in their school.

The nature of symptomatic responses was different in relation to each dimension of the framework, and this feeds directly into the discussion of taming and tackling behaviour, which will be discussed in Section #7.5.

**Systems Loop:** Complexity and Ambiguity (The confusion loop) Faced with the multitude of possible causes involved in the wicked problem and the many different ways people made sense of the problem, there was a natural reaction of confusion. A number of participants used the same language to describe how they were feeling: "It's just too much and I can't get my head around it." Confusion was also expressed in questions such as: where to start, how to begin and what to do?

**People Loop:** Diversity and Intractability (The blind spot loop) The significant symptomatic response in this loop was what people did not place on their maps. Areas of significant concern for one group, such as 'government' for the DEEWR participants, did not even appear on the maps of other groups. In the case of the lack of 'students' appearing as a cause on school cluster maps, the reason given when questioned was, "Oh, of course students – that's a given!" In this case, it is such an obvious cause to these stakeholders that its presence on their radar didn't warrant mention. This was an example of a blind spot of expertise, as opposed to a blind spot of ignorance.

**Context Loop:** Instability and Constraints (The loop of despair) Constant changes in their environment and the many constraints that restricted meaningful action led many participants to display symptoms of despair and hopelessness. 'What's the

point?' was a phrase overheard a number of times and in almost all cases was linked to one of the two dimensions in the context loop.

## 7.5 Taming Or Tackling: Participant Responses

A key characteristic of wicked problems is that they cannot be solved like tame or technical problems. However, the literature also identifies that tackling wicked problems appropriately is not a natural response for most people. The most common response is to attempt to tame the problem in various ways (Conklin, 2005, p. 19).

In this research, participants agreed that they confronted a difficult problem, but differed in how they responded to it in general, and how their responses relate to each dimension of the framework. For each dimension, their thinking and behavior tended to exhibit some form of either 'taming' or 'tackling'. The responses from participants aligned in general with the literature, but the Niche framework provided further texture and colour along each of the dimensions as to how and why people chose particular behaviours. This section looks in detail at the taming or tackling approaches of participants along each of the six dimensions of the Niche framework.

A tame problem, according to the Niche framework, is low in most of the six dimensions of the framework. For a tame problem this means that

1. It may be highly complex, but there are no other complicating factors (i.e. it does not rate highly on any of the other dimensions)

2. It is clear what the problem is, with agreement on the 'facts'

3. The people and groups involved share similar paradigms or frames …

4. … and are able to work cooperatively with other stakeholders

5. The context within which the problem is occurring is stable …

6. … and doesn't suffer from multiple, severe constraints.

In contrast, a wicked problem is high in multiple dimensions of the framework. To illustrate this difference Figure #7.3 shows a comparison of tame and wicked problem radar graphs. The graph on the left shows a hypothetical problem that is highly complex but low in all the other dimensions, thus making it tame. The graph on the right is taken from Figure #7.2 that was a subjective visual representation of the results from this study.

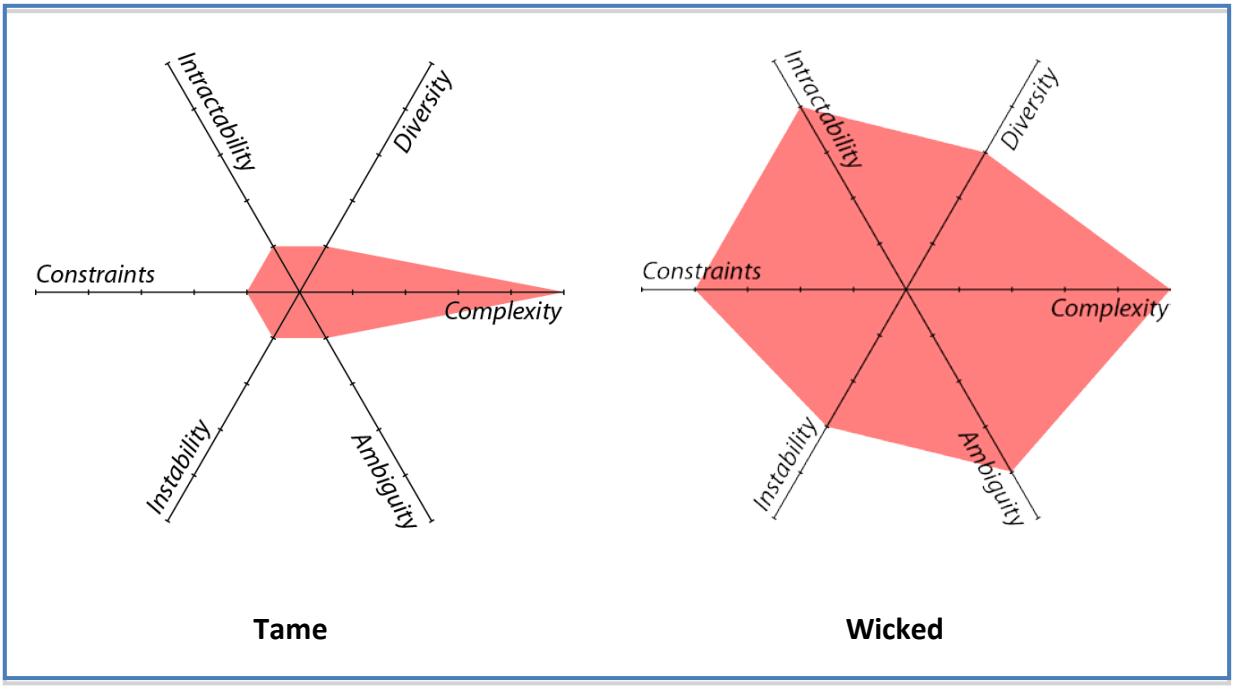


Figure 7.3 Comparison of tame and wicked problem radar graphs

The findings from the mapping process, as shown in the right hand graph of Figure #7.3, demonstrated that low numeracy achievement of low SES students rates highly in most dimensions, and is therefore not a tame problem but wicked. The growing awareness of this caused different types of reactions in participants. A few embraced

the challenge and sought to deal with the emerging 'reality' of the problem (tackling), while most tried to put the issue 'back in the box' so it would seem manageable and not so overwhelming (taming). These 'symptoms' in response to a wicked problem align with my own experience as a consultant as outlined in Chapter #3 of this thesis.

Since the mapping involved some level of collaboration, the taming or tackling behaviour had to occur in relationship with one or more colleagues and often with one or more of the project leaders and myself as facilitator. This created a potential for difference and conflict in reactions between participant teams members, and influenced how people reacted, with some of the behaviours geared towards managing the interaction as well as dealing with the emerging problem.

As each loop in the framework has a different focus (people, systems or context), so the responses to wickedity were different for each. Therefore I will outline the nature of the taming or tackling responses for each loop in relation to its particular focus and then draw them together.

### 7.5.1 Taming or tackling complexity and ambiguity

Most participants struggled with the complexity and ambiguity that emerged during the mapping process. This was with both the causes and the linkages between them. The behaviours displayed and observed in these responses to dealing with this complexity can be divided between attempts to either tackle or tame the problem. Tackling behaviours acknowledged the complexity and ambiguity, and tried to work with them as part of the reality of the problem. In contrast, taming behaviours sought ways to reduce the complexity and ambiguity or their consequences. These various behaviours are listed in Table #7.2, with responses to complexity first, followed by those to ambiguity.

| *Table 7.2 Taming vs tackling behaviours* | |
|---|---|
| ***7.5.1.1 Taming behaviours*** | ***7.5.1.2 Tackling behaviours*** |
| • Limiting the addition of new causes | • Freely generating more causes |
| • Ignoring the majority of causes | • Attempting to address all causes |
| • Grouping unrelated causes | • Grouping causes into more manageable chunks |
| • Narrow, single focus | • Moving from one focus to another |
| • Following a single causal thread | • Moving from thread to thread and linking multiple threads |
| • Using authority to privilege a cause/s | • Seeking to understand causal linkages |
| • Limiting linkages | • Linking freely |
| | |
| • Locking down definitions | • Accepting multiple definitions |
| • Assuming singular meaning | • Questioning meanings |
| • Consider there are only a few solutions | • Consider multiple interconnected solutions |

Many of these behaviours are noted in the literature. However, what emerged here that is not explicit in the literature is the often conscious choice to tame the problem. Where some participants embraced the emerging wickedity of the problem (which then confirmed for them why it had been so hard to solve), for others, to admit that the problem was this complex and ambiguous was tantamount to admitting that it was unsolvable and therefore hopeless. Consequently, they consciously worked to reduce the complexity and ambiguity by changing their maps or choosing not to add more complicating factors.

### 7.5.2 Taming or tackling diversity and intractability

Participants responded to the dimensions in the people loop (diversity and intractability) in a different way to complexity and ambiguity. These responses were generally expressed in the nature of the maps that different individuals and groups produced. Maps tended to display a limited set or profile of causes that

differed between groups and related to their work context and paradigms. These differences show that each person has their own fields of interest and 'blind spots'. This can be explained as a passive response to a wicked problem based on the dominant paradigm or frame of the individual or group (Schon, 1999).

Participants did not set out to actively exclude certain areas of cause but just seemed oblivious to them, building their maps from their own perspective. When other groups' maps were displayed, most people accepted the new collection of causes but in practice ignored them and did not refer to them. To successfully tackle a wicked problem these differences need to be surfaced and the various ways of making sense made explicit and explored.

The limited nature of this research makes intractability harder to identify but some examples were observed. For example, some participants talked of a cause such as student absenteeism as 'just a fact of life' and not open to change.

### 7.5.3 Taming or tackling constraints and instability

The context loop could almost be called the 'loop of despair'. Symptomatically, participants expressed powerlessness when confronted with the many constraints they had to deal with, and a feeling of pointlessness when faced with the highly dynamic nature of their contexts. Coping with these feelings in turn led to a view that many of the identified causes were "somebody else's problem" (SEP) (Adams, 1990) and not something they had to confront themselves.

This response is important for understanding why and how stakeholders attempt to tame a wicked problem. All of the participants were busy people and had limited time to think about difficult issues. Therefore there was a tendency to work on the clearly controllable causes, which were within their sphere of immediate influence

(Covey, 2004, pp. 81-88) and stable enough to have some lasting impact. More indirect, changing or distant causes were put to one side even if they had been acknowledged as critical to any viable improvement to the situation.

In contrast, a few chose to tackle the constraints and instability directly. Their tackling behaviour involved strategic and long term thinking that embraced the need to deal with difficult decisions and consider underlying issues. They followed through the causal links in their maps and began to explore what, if anything, could be done to deal with some of the severe constraints they faced. One example of this I observed through discussion with a participant during a drive from a workshop back to the hotel. A school principal, this person had received a call about interviews for new staff. New teachers were hard to get and this was a major factor of instability in the school and a constraint on student achievement. Previously, he explained, if an 'applicant had a pulse' they got the job. As a new principal, he considered that this 'solution' was causing more problems, and therefore he had instituted a policy that only 'quality' teachers would be employed. This tackling behaviour created high personal cost and required a strong commitment to long-term benefits over short-term advantages.

The instability caused by the transience of staff provides a second example. This was expressed in the maps as 'retention of quality staff'. Both taming and tackling thinking and behaviours were exhibited in response to this issue. While all participants considered it a problem, particularly for remote indigenous schools, there was a marked difference in approach between the NT and WA Kimberley school clusters. Most of the NT people (with one exception) despaired of ever being able to do anything about this issue, while in the Kimberly it became a specific topic of discussion, particularly as it related to sustainability of change as a result of the project. Ideas were proposed for some form of induction for new teachers and the setting up of policies and systems that would enable them to quickly get up to speed.

Thus the tackling mindset was creative and optimistic but not unrealistic in what they set out to achieve. In comparison, the taming mindset had already conceded defeat and either ignored the recognised major problem causes or focused on a controllable sub-problem that would not resolve the larger issues.

## 7.6 Chapter Summary

This chapter has applied the Niche framework to the research findings from Chapter #6. The detailed findings were able to be mapped to a radar graph that used the Niche framework to provide a comprehensive and coherent summary of the multiple dimensions of the problem. Each dimension of the framework was evident in the findings and helped to clarify the wicked nature of the problem. The framework helps explain the participants' symptomatic reactions to the problem as well their taming or tackling behaviours.

The range of findings on this wicked problem have been outlined in Chapter #6. These findings have then been further analysed and explained using the Niche Framework. The final step in this study is to consider its implications, evaluate the use of the framework for policy development, and make relevant recommendations for future research. This will be the task addressed in Chapter #8.

# 8 Conclusions, Implications & Recommendations

## 8.1 Introduction

The purpose of this research was to trial a framework and related tools for tackling wicked problems, with specific application to the problem of low levels of numeracy achievement of students in low socioeconomic school communities. There are three interwoven strands of questions that flowed from this stated purpose. The first addressed the patterns of participant understanding of the causes of the identified wicked problem, which emerged from the collaborative activities undertaken through the LAND project. The second thread focussed on the causal mapping process used in the LAND workshops. The third relates to the utility and value of the Niche Wicked Problem Framework.

The participants' responses to these questions produced a wealth of findings that provide insights into understanding and tackling this particular wicked problem and, by extension, wicked problems in general. The Niche framework and related tools were successfully used to develop a better shared understanding between participants and greater clarity of the problem's dimensions. Collaborative causal mapping was found to be a practical and effective means of eliciting stakeholder thinking about causes and effects of wicked problems by acting as boundary objects.

This chapter provides a combination of conclusions and recommendations from the findings and related discussions, with a particular focus on the implications for public policy development. A summary list of recommendations is provided in Section #8.4.1 and referred to throughout the chapter.

## 8.2 Implications For Theory & Practice

Although the term 'wicked problem' has been used in academic circles since the 1970s, the literature on wicked problems has been sparse until the last five years. Since then the number of articles has almost doubled every year. This diverse and growing literature deals primarily with the characteristics of wicked problems, but also includes recommendations for processes and tools for tackling this type of problem. The findings from this study align with the literature in many ways, including identifying the multiplicity of dimensions of a wicked problem, and confirming the value of collaborative approaches for tackling such problems. It extends this body of knowledge by validating a particular set of collaborative processes and tools, and demonstrating the value of the Niche framework. These tools and framework helped illuminate and clarify the actual views of stakeholders involved in the problem under investigation.

The impact of this research project has been significant for practice in a number of ways. First, it has confirmed that this particular problem is 'wicked', which has implications for stakeholders and policy developers in how it should be tackled. Second, it has provided insights into the different perspectives of the knowledge cultures involved in the problem. Finally, it has had positive outcomes both corporately and individually for the participants involved in the study.

### 8.2.1 Confirming the problem in the study as 'wicked'

From the findings in this study it can be concluded that the problem of the ongoing low level of numeracy achievement of students in low SES school communities is indeed 'wicked', as defined by the relevant literature reviewed in Chapter #2. The findings align with this literature in the following ways:

- **Characteristics similar:** The findings regarding the nature of the problem under investigation resulted in characteristics similar to those described in the literature. The Niche framework provides a summary of these characteristics, and relevant conclusions are presented in Section #8.3.3 focusing on the value and potential of this framework.

- **Differences in frames, resulting in different perceptions of the problems:** Section #8.2.2 presents a summary of and conclusions pertaining to the differences in the perceptions of the various stakeholder groups.

- **Taming and tackling behaviours:** Participants responses to the problem as articulated in their maps and discussions demonstrated a range of both taming and tackling behaviours. The conclusions and recommendations related to this are presented in Section #8.2.4

- **Collaborative strategies effective:** The scope of this study did not allow for a comparison of different strategies for tackling wicked problems but it did provide an opportunity to assess the value of a particular set of collaborative processes, which were found to be effective in this context. Conclusions and recommendations for this are presented in Sections #8.2.3.1 and #8.2.5.

The conclusion, that this particular problem is wicked, leads to several recommendations for research and practice. Relevant education and government agencies should treat this particular problem as wicked so that appropriate responses can be developed (Recommendation #9). Also, the process and tools from this study should be applied to research on other wicked problems (Recommendation #2), so that the value of this approach can be explored further.

### 8.2.2 The value and potential of the Niche Wicked Problem Framework

The third thread of research questions in this study was designed to investigate the explanatory and analytical value of the Niche framework. In other words, in what ways does the framework

(i) Provide explanatory value

(ii) Make sense of symptoms

(iii) Identify taming and tackling behaviours

(iv) Inform policy development

In Chapter #7, the Niche framework was applied to the findings, providing answers to each of these research questions and leading to the conclusion that the Niche framework provides a comprehensive and coherent way of making sense of the range of stakeholder thinking about this particular wicked problem. The framework, through the use of its six dimensions, summarised the literature on wicked problems, and could provide a basis for future discussion and action on this particular problem. The framework also offered possible explanations for the symptoms and behaviors the participants expressed and exhibited during the study. Consequently it is recommended that the Niche framework be trialed as a tool for assessing the wickedity of policy issues (Recommendation #12) so that appropriate policy responses can be developed. It would also be worth exploring the use and value of other frameworks that have been used to support the tackling of wicked problems (Recommendation #1).

### 8.2.3 Validating the process and tools

The research on education policy development as a wicked problem includes little exploration of the value of using a framework and related tools for tackling such problems. The findings from this research support the conclusion that the process, framework and tools used in this research have been effective in providing participants with new ways to tackle the wicked problem they face.

In particular, the value of such a framework and tools was seen in terms of the manner and extent to which they supported the enhancement of a shared understanding and construction of meaning between individuals and groups. The successful use of collaborative causal mapping as both a research method and boundary object was significant through providing a rich and detailed set of data as well as insights into the thinking of the stakeholders involved in the research.

#### *8.2.3.1 Causal mapping and facilitated dialogue as tools for tackling wicked problems*

The second thread of research questions in this study focused on the workshop activities, using causal maps, and asked the core question, 'Does this process improve participants' understanding of the 'wickedity' of the problem? The conclusion from the results is 'yes'. The use of the facilitated, collaborative mapping sessions helped identify the evolving nature of the problem, as well as stakeholders' understanding of what was required to improve the situation.

The mapping activities developed key skills identified in the literature as essential for tackling wicked problems, including

4. An increased shared understanding between stakeholders (Conklin, 2005)

5. A willingness to consider the problem from a holistic point of view (V. Brown, 2008; V. Brown, et al., 2010; Gray & Gill, 2009; Waddock, 1998)

6. Collaborative and transdisciplinary approaches that enabled the tacit frames of stakeholders to become more explicit and comprehendible to other stakeholders (Aboelela, et al., 2007; Bore & Wright, 2009; Cutler & Burry, 2010; Polk & Knutsson, 2008).

The causal maps also functioned well as boundary objects providing a shared visual space for collaboration and dialogue. The results showed four dialogical learning mechanisms (Akkerman & Bakker, 2011) , (identification, coordination, reflection and transformation), evidenced in the interactions of participants. Consequently, it is recommended that further research be conducted into the value of using boundary objects for tackling wicked problems, including the use of causal mapping as a tool for collaborative dialogue and professional reflection (Recommendation #7).

The content and structure of the finished maps raised questions for further research that are beyond the bounds of this study. For example

- What is the nature of 'leadership' as it is conceptualised by the different knowledge cultures involved in education? (Recommendation #5)
- How does the history of the relationship dynamics of a group affect how they think about a wicked problem and what processes they choose to tackle it? (Recommendation #6)

The physical process of drawing resulted in some unexpected sketches, diagrams and notation on the maps of participants. Further exploration of these drawing notations could link with other visual methods for social research (Mutonyi & Kendrick, 2011; Theron, Mitchell, Smith, & Stuart, 2011) (Recommendation #8).

### 8.2.4 Insights into different frames of understanding on numeracy achievement

A key characteristic of wicked problems, demonstrated in this study, is the different perspectives stakeholders hold regarding the same problem. When the results from the mapping activities of the three knowledge cultures (Schools, CEOs and Federal Government) were compared, patterns of distinctiveness for each group were identified and described in Chapters #6 and #7, and summed up in a radar graph in Figure #6.21.

This graph shows the range of ***emphasis*** in the use of terms chosen by the different groups, identifying three distinctive groupings on the graph. The Niche framework was then used in Chapter #7 to note that in addition to differences in emphasis, the ***focus*** of the groups also differed, for example:

- DEEWR personnel focused on causes linked to the 'system' loop
- The CEOs focused on certain aspects of the 'people' loop
- The school clusters focused on different aspects from the 'people' loop and some causes that relate primarily to the 'context' loop.

These differences in focus and emphasis allow us to conclude that there is limited alignment between the different stakeholder groups in their perspectives on the underlying causes related to the wicked problem of ongoing low levels of numeracy achievement of students in low SES school communities.

The distinctive perspective of each of the knowledge cultures in this study also enriches the understanding of this particular wicked problem. Future research should explore what supports and reinforces these perspectives and how the limitation of alignment in thinking affects policy implementation (Recommendation #3 & #4).

#### *8.2.4.1 Taming and tackling behaviours*

As has been noted a number of times in this study, the most common response when confronted with a wicked problem is to attempt to tame the problem in various ways (Conklin, 2005, p. 19). The findings discussed in Chapters #6 & #7 agreed in general with the literature on the types of taming approaches taken but the Niche Framework provided further texture and colour along each of the dimensions as to how and why people choose particular behaviours. In contrast some participants exhibited various tackling behaviours that had a positive impact on trying to improve the problem. In light of these results I recommend that research be conducted into the specific types of taming and tackling behaviours stakeholders engage in when confronted with a wicked problem. This should include an exploration of why particular behaviours are chosen by stakeholders so as to give insight into the thinking of those confronted with wicked problems.

### 8.2.5 Outcomes for participants

The activities in this study resulted in corporate and individual outcomes that were generally viewed positively by participants.

#### *8.2.5.1 Corporately*

**Planning:** A number of teams from the school clusters and CEOs noted that the collaborative causal mapping had provided them with useful tools for planning. For example, one school incorporated the process into their strategic planning during the project while another stated that they would be utilising the maps from the final workshop in an upcoming planning session. This could be promoted by the CEO as a tool for developing collaborative approaches to planning (Recommendation #17).

**Improving dialogue:** The results demonstrate the potential for collaborative dialogue for improving team interactions, and provide another area for future

research. Questions could include: Could collaborative causal mapping be used as a team building tool? If so, what is the most effective structure for the related activities? (Recommendation #16)

**Increased shared understanding:** Following the research activities most groups commented that they had a better understanding of each other and of the problem as whole. This is seen in the literature as critical for successfully tackling wicked problems and is therefore a significant conclusion to draw from the findings (V. Brown, et al., 2010, pp. 75-79). Further, this supports a recommendation for further research utilizing the processes and tools used in this study (Recommendations #2, 7, 9, 10, 11, 12 & 18).

#### *8.2.5.2 Individually*

The individual participants ranged in their view of the value of activities associated with this research, but most expressed positive opinions through the project surveys, personal discussions and the final school presentations.

**Changed thinking:** Most participants stated that their thinking had changed during the LAND project, with the causal mapping activities being singled out for mention as a process that provided a new way of approaching the problem.

**Improved dialogic skills:** As discussed in Section #6.3.4, for many of the participants there was clear evidence of the collaborative activities leading to improved dialogic skills.

Therefore there is clear value in developing these skills in principals and teachers and, accordingly, the CEO should provide relevant professional development (Recommendations #16, 17 & 18).

The conclusions and recommendations for theory and practice presented in this section have direct implications for the next section, which presents conclusions relating to public policy in education and schooling.

## 8.3 Implications For Policy

As stated in Chapter #2 there are multiple definitions of public policy (McConnell, 2010, pp. 4-6), each focussing on different aspects of "whatever governments choose to do or not to do" (Dye, 2005, p. 1). This ambiguity in such a key term can make it difficult to discuss the impact of wicked problems on policy development, as the nature of that impact is dependent on the definition of both the terms 'wicked problem' and 'policy'. This is just as true for the implications for policy arising from this study. Therefore, to provide a foundation for the conclusions and recommendations in this section the two policy heuristics introduced in Chapter #2 are used here. The headings for the subsections in this chapter are based on McConnell's (2010) three dimensions of policy success, each supplemented by Colebatch's model of aspects of policy practice.

The conclusions from this study have a direct bearing on how low levels of numeracy achievement of students in low SES school communities should be approached from a policy process, programme and political dimension. Furthermore the implications for wider policy application align with the recommendations from the APSC (2007, pp. 35-38) discussion paper on tackling public policy .

### 8.3.1 Process, programme and political dimensions of policy

McConnell's three dimensions of policy success are summarised as

- **Process:** refers to policy-making and implementation (McConnell, 2010, p. 40).
- **Programmes:** refers to the outcomes from specific government action (McConnell, 2010, p. 46)
- **Politics:** defined as pertaining to government, its capacity to govern and the values it seeks to promote (McConnell, 2010, p. 50)

Table #8.2 shows each of these dimensions in the left column with a corresponding list of potential measures of policy success in the right column.

| *Table 8.2 Three Main Dimensions of Policy Success* | |
|---|---|
| Process | Preserving policy goals and instruments<br>Conferring legitimacy<br>Building a sustainable coalition<br>Symbolizing innovation and influence |
| Programmes | Meeting objectives<br>Producing desired outcomes<br>Creating benefit for target group<br>Meeting policy domain criteria |
| Politics | Enhancing electoral prospects/reputation of governments and leaders<br>Controlling the policy agenda and easing the business of governing<br>Sustaining the broad values and direction of government |

#### *8.3.1.1 Process*

Chapter #2 of this study introduced the concept of two different types of policy problems: tame and wicked. Tame policy problems can be solved with traditional, technical processes and tools. Wicked problems, on the other hand, require more innovative processes and tools that are designed to deal with their particular

characteristics. Table #2.4 summarised these differences and can be used as a foundation for the conclusions drawn from the study in this section.

This research successfully utilised a number of the processes and tools listed in the 'wicked' column of Table #2.4 and these should be considered when designing future interventions in schools that attempt to improve numeracy (Recommendations #10, #12, #13, #14 & #15). These recommendations align with the recommendations in the APSC (2007, pp. 35-38) document on tackling wicked problems.

These conclusions and recommendations also have implications for policy practice as presented by Colebatch (2009, p. 35), introduced in Chapter #2 as Figure #2.1 'Aspects of policy practice'. The relevant part of his diagram is the representation of boundaries around implementers, stakeholders and their different shared understandings. Traditionally, the process of policy development keeps these groups separate or interacting in a limited way across these clear boundaries. In contrast, tackling wicked problems requires collaborative interactions between stakeholders across these boundaries.

The implications of crossing boundaries flow onto McConnell's (2010) measures of policy process success. Treating the problem as wicked means that each of the four measures listed in the process part of Table #8.2 require genuine engagement and involvement with all stakeholders (Recommendations #11, #12 & #13).

#### *8.3.1.2 Programmes*

If the problem in this study is treated as wicked there are significant implications for policy programme success. Since we have already concluded that stakeholders in this study have demonstrated different frames of understanding, this poses a difficulty for any attempt to apply the four measures of success (meeting objectives,

producing desired outcomes, creating benefit for the target group and meeting policy domain criteria), listed by McConnell (2010). Whose frame will be used to assess success? For example, the objectives of the DEEWR participants had little or no overlap with those of the school participants. At a more detailed level, each of the school teams addressed the problem from within their specific contexts, making any generic policy solution problematic.

To address this difficulty I recommend that effort be spent on contextualising policy development for the different stakeholder groups involved (Recommendation #11). This aligns with other research that has recommended that policy 'enactments' should not move towards "greater standardization, coordination, and integration" (Fenwick & Edwards, 2011, p. 709) but that effort should be spent on trying to "practice and communicate across different worlds" (Fenwick & Edwards, 2011, p. 724). This would require DEEWR to build on the findings from this study by exploring and developing an understanding of the different frames of understanding held by the stakeholders associated with the wicked problem of low levels of numeracy achievement of students in low SES school communities. Contextualising policy programmes flow naturally to some more general recommendations relating to the whole of government. First, government agencies should promote a culture of engagement and collaboration through developing structures and activities for stakeholders to develop a shared understanding of wicked problems (Recommendation #12). Second, Federal government should extend and embed a whole-of-government approach by working across organisational boundaries and engaging with citizens and stakeholders through trialling the use of collaborative dialogic tools, such as causal mapping, in their consultations.

The conclusions presented in the sections on the process and programme dimensions of policy have implications for McConnell's final policy dimension, politics, discussion of which follows.

#### *8.3.1.3 Politics*

This third dimension of policy success relates to the political repercussions of policy choices and outcomes. McConnell (2010, p. 228) notes that, from a political perspective, success in policy process and programme is not always desirable, as there are "many public policy problems where political pay-offs are far greater than programmatic pay-offs." This is linked to the political importance of appearing to deal with a problem, often by taming it, but in reality doing little or nothing about it (Weatherburn, 2012). This approach has been labelled by McConnell (2010, p. 228) as developing 'symbolic' or 'placebo' policies. Wicked problems are specifically referred to in this context due to their high symbolic value and because "governments cannot hope to offer a clear solution to problems rooted in almost overwhelming complexity" (McConnell, 2010, p. 229). The findings from this study align with this view, as the problem under investigation has been recognised by those involved as complex, intractable and involving multiple stakeholder groups holding differing views on the nature of the problem and any proposed solutions.

Furthermore, the recommendations presented in this chapter will be difficult to implement from a political perspective since each of the three policy-politics success measures listed in Table #8.2 are likely to be threatened by a truly collaborative approach to tackling wicked problems because the power and control shifts from the government to a sharing between stakeholders. Consequently, it is the hope of this author that there will be a degree of political bravery by those in power when faced with the recommendations from this study.

This completes the conclusions and recommendations from the findings in this study. The next section summarises the various recommendations made in this chapter.

## 8.4 Summary Of Recommendations

The recommendations from the previous sections in this chapter are summarised here.

### 8.4.1 Recommendations for future research:

Recommendation #1 A comprehensive review into the use and comparative value of different frameworks and models used to support the tackling of wicked problems with a view to providing stakeholders with suite of relevant and tested tools.

Recommendation #2 Utilisation of the research process and tools from this study in research on other wicked problems, to explore the value of this approach as a research method.

Recommendation #3 Research to explore what 'alignment' between the different layers of educational system means to relevant stakeholders so that appropriate terminology can be developed.

Recommendation #4 Research into what supports and reinforces the different stakeholder perspectives and how the lack of alignment in thinking affects policy implementation.

Recommendation #5 Research on how the concept of 'leadership' is conceptualised by the different knowledge cultures involved in education, and the implications of these conceptualisations considered for changes in practice.

Recommendation #6 Qualitative research on how the history of the relationship dynamics of a group affect how they think about a wicked problem and what processes they choose to tackle it.

Recommendation #7 Further research on the value of the use of boundary objects for tackling wicked problems, including the use of causal mapping as a tool for collaborative dialogue and professional reflection.

Recommendation #8 Research into the specific types of taming and tackling behaviours stakeholders engage in when confronted with a wicked problem. This should include an exploration of why particular behaviours are chosen by stakeholders so as to give insight into the thinking of those confronted with wicked problems.

Recommendation #9 Exploration of drawings, scribbles and notations on concept maps as a potential visual method for social research.

### 8.4.2 Recommendations for policy and practice

#### Policy development and implementation

Recommendation #10 All levels of government and the education system should treat the problem of low levels of numeracy achievement of students in low SES school communities as 'wicked' so that appropriate approaches to the problem can be developed.

Recommendation #11 DEEWR to explore and develop an understanding of the different frames of understanding held by the stakeholders associated with the wicked problem of low levels of numeracy achievement of students in low SES school communities

building on the findings from this study so that policy design can be contextualised for each of the stakeholder groups.

Recommendation #12 Government agencies to promote a culture of engagement and collaboration through developing structures and activities for stakeholders in order to develop a shared understanding of wicked problems.

Recommendation #13 The Niche framework to be trialled to assess what policy issues are wicked problems, so that appropriate policy responses can be designed, developed and implemented.

Recommendation #14 Federal government to extend and embed a whole-of-government approach by working across organisational boundaries and engaging with citizens and stakeholders through trialling the use of collaborative dialogic tools, such as causal mapping, in their consultations.

Recommendation #15 DEEWR to incorporate training and case studies on tackling wicked problems into professional development for policy developers in order to increase levels of critical thinking.

### Teaching practice and professional development

Recommendation #16 The potential of collaborative dialogue as a team building tool to be explored by the CEO through the development of relevant training.

Recommendation #17 Collaborative causal mapping to be promoted by the CEO as professional development of teachers for strategy, planning and problem solving.

Recommendation #18 Catholic Education Offices to work with schools to develop multi-school forums for professional dialogue on educational wicked problems.

## 8.5 Concluding Remarks

This final chapter has presented conclusions, implications and recommendations based on the presentation of the findings in Chapter #6 and the application of the Niche framework to these findings in Chapter #7. The conclusions from this study align with the literature, in identifying the multiplicity of dimensions of wicked problems, and confirming the value of collaborative approaches for tackling them. It extends this body of knowledge by validating a particular set of collaborative processes and tools, and demonstrating the value of the Niche framework. These tools and framework helped illuminate and clarify the actual views of stakeholders involved in the problem under investigation.

The impact of this research project has been significant for practice in a number of ways. First, it has confirmed that this particular problem is 'wicked', which has implications for stakeholders and policy developers in how the problem should be tackled. Second, it has provided insights into the different perspectives of the knowledge cultures involved in the problem. Finally, it has had positive outcomes both corporately and individually for the participants involved in the study.

The conclusions from this study have a direct bearing on how low levels of numeracy achievement of students in low SES school communities should be approached from the policy dimensions of process, programme and politics. Furthermore the implications for wider policy application align with the recommendations from the APSC (2007, pp. 35-38) discussion paper on tackling public policy .

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# *10 Appendices*

## 10.1 Appendix #1 Surveys

- LAND Participant Survey schools
- LAND Participant Survey CEOs
- LAND Participant Survey DEEWR

## 10.2 Appendix #2 Pathways to Improving Numeracy

- Pathways to Improved Numeracy: Analysing SA & NT Causal Maps
- Pathways to Improved Numeracy: Analysing The Kimberley & Perth Causal Maps

## 10.3 Appendix #3 Participant Maps – (DVD)

- Groups Maps – Synthesis of results
- Participant Maps

AUSTRALIAN CATHOLIC UNIVERSITY

# LAND WORKSHOP 4 SURVEY

Thank you for your honest feedback on this week's workshops. Your insight is essential.

1. **Your name or pseudonym:** _____

2. **Your school:** _____

3. **For each of the following questions, choose the number that best reflects the degree to which you agree with a given statement.** ***1 indicates a low level of agreement, while 6 indicates a high level of agreement.***

i. Numeracy achievement has a high priority in my classroom.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

ii. Numeracy achievement has a high priority in our school.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

iii. Numeracy achievement has a high priority in our system.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

iv. School staff shares a sense of common purpose about numeracy teaching & learning.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

v. Professional development at school level assists teachers improve numeracy achievement.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

vi. Professional development at system level assists teachers improve numeracy achievement.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

vii. My leaders offer the support and encouragement I need to improve numeracy achievement.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

viii. My leaders challenge me to improve the quality of my professional practice.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

ix. My system supports me to improve the quality of my professional practice.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

x. My system challenges me to improve the quality of my professional practice.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

xi. I am a reflective practitioner.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

4. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of participation in the LAND project on NUMERACY DEVELOPMENT for our students as:** 1 2 3 4 5

   What evidence do you have for this?

   _____

   _____

   _____

5. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of participation in the LAND project on LEADERSHIP PRACTICES for numeracy development as:** 1 2 3 4 5

   What evidence do you have for this?

   _____

   _____

   _____

6. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of the LAND project in improving ALIGNMENT among classroom, school and system numeracy and leadership practices as:** 1 2 3 4 5

   What evidence do you have for this?

   _____

   _____

   _____

7. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of the school visits by the ACU team on our numeracy and leadership practices as:** 1 2 3 4 5

   What evidence do you have for this?

   _____

   _____

8. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of the LAND Project Officer on our numeracy and leadership practices as:**

1 2 3 4 5

What evidence do you have for this?

_____

_____

_____

9. **On a scale of 1 (negative or no influence) to 5 (major positive influence), I would rate the influence of the "shoulder to shoulder" visits on our numeracy and leadership practices as:**

1 2 3 4 5

What evidence do you have for this?

_____

_____

_____

10. **The greatest obstacles to improving numeracy in my school/system during LAND have been:**

_____

_____

_____

_____

_____

_____

_____

**11. The things that have been of greatest assistance in developing numeracy in our students during LAND have been:**

_____

_____

_____

_____

_____

_____

**12. These are the changes I have observed during the LAND process which have contributed to the overall outcome. Only respond to those where you have seen change.**

System support: _____

School leadership: _____

Agreed practice: _____

Professional development: _____

Resources: _____

Teacher confidence: _____

Teacher knowledge: _____

Pedagogy: _____

Curriculum documentation: _____

Staff collaboration: _____

Assessment and reporting: _____

Alignment of classroom, school and system: _____

_____

**13. Is there anything else you would like to tell us at the end-point of our journey?**

_____

_____

_____

_____

_____

_____

_____

_____

_____

# The LAND Project

## An Australian Catholic University partnership with:

Catholic Education Office of Western Australia

northern territory diocese of darwin catholic education office

**Catholic Education Office of South Australia**.

The following brief survey is similar to the two provided to school participants of the LAND project. We have changed questions to be relevant for Catholic Education Office staff.

Thanks for taking the time to complete it, please return your survey **directly to Craig Ashhurst via email (craig@nichethinking.net.au) – at least one week prior to the scheduled event, i.e. by 2 September – thanks**

Mike Gaffney
Craig Ashhurst

# Survey Questions

1. **Name**:

2. **Role/position title:**

3. **What are your key program and policy responsibilities?**

4. **What do you see as significant <u>obstacles</u> to improving student numeracy achievement across your school system?**

5. **What do you see as significant <u>opportunities</u> for improving numeracy achievement across your school system?**

# LEADING ALIGNED NUMERACY DEVELOPMENT (LAND)

## An Australian Catholic University partnership with:

Catholic Education Office of Western Australia

northern territory diocese of darwin catholic education office

**Catholic Education Office of South Australia**.

**Funded under Australian Government Department of Education, Employment and Workplace Relation, *Literacy and Numeracy Pilots in Low SES Communities* Initiative**

The following survey is similar to the two provided to school and central office participants of the LAND project. We have adjusted questions to be relevant for DEEWR staff.

Mike Gaffney, michael.gaffney@acu.edu.au
Craig Ashhurst, **craig@nichethinking.net.au**

# Survey Questions

1. **Name**: _____
2. **Role/position title:**
3. **What are your key program and policy responsibilities?**
4. **What do you see as significant <u>obstacles</u> to improving student achievement (e.g. literacy and numeracy) in low SES school communities?**
5. **What do you see as significant <u>opportunities</u> for improving student achievement (e.g. literacy and numeracy) in low SES school communities?**

Thank you for taking the time to complete it, please return your survey **directly to Craig Ashhurst via email (craig@nichethinking.net.au) – at least one week prior to the scheduled event, i.e. by [tba]**

# Pathways to Improved Numeracy: Analysing SA & NT Causal Maps

This document contains results and observations from the causal mapping activity conducted during the third series of LAND workshops.

Each section is focussed on one major grouping of causes and contains questions sparked by our observations. Referring to the handouts, please choose an initial area for discussion in your group. Appoint a scribe to make notes. Once you have covered this area, please move on to the next one of interest.

==========

***Evidence**: Many types of evidence were identified by school teams for demonstrating improved numeracy.*

What are the most useful forms of evidence of student achievement in numeracy at your school? Why? What effect is this evidence having at your school?

***Thinking about Improvement: '**Vision' and 'a united desire for students' to do their best were highlighted as important causes for improved numeracy:*

What is your school's vision for improved numeracy? How was it developed? What purpose(s) does your vision serve? What does it affect? How do you know?

Why do you think 'vision' and 'united desire for students to do their best' stand out from the other causes listed?

***Community**: Students can improve their achievement in numeracy if they are healthy, resilient, attending and engaged. This involves taking steps to ensure students are well served in terms of professional services (e.g. special needs, language support, community health) and parental/home support.*

What steps are underway at your school to ensure these services and forms of support are in place? What is enabling these steps to be taken? What impacts are they having? How do you know?

*The causes listed in the community bubble are grouped differently between the NT & SA maps. Both groups selected a part of the community bubble as one or more of their number one causes but NT selected students and SA chose school.*

Why do you think the two clusters have these different emphases?

***Professional Development:*** *The combination of regular in-school professional development with access to external support (e.g. by involvement in LAND) was highlighted as an important cause of improved numeracy.*

What is an example of effective professional development at your school? How is professional development embedded in your school culture? What effect is it having? How do you know?

***Teaching and Teachers:***

*Teachers have a significant 'in-school' effect on student achievement in numeracy – who they are, and how and what they teach. This was evident in the range of characteristics associated with 'Teaching' and 'Teachers', and in the responses to the 'top three causes' question.*

Think of an effective teacher of numeracy at your school:

- What are their most impressive personal qualities? (What type of person are they?)

- What are their most significant professional practices? (How and what do they teach?)

- How is their work (i) influencing and (ii) being influenced by others (students, school colleagues and parents)? How do you know?

***Organisation:*** *Improved student numeracy achievement requires collaboration and supportive organisation and programming.*

What organisational features have been put in place to support improved numeracy at your school? What has enabled these features to be put in place? What are these features affecting most directly?

*The area of 'organisation' had the largest number of individual causes listed but only a couple of teams rated it in the top three causes.*

Why do you think this is the case?

# Pathways to Improved Numeracy: Analysing The Kimberley & Perth Causal Maps

This document contains results and observations from the causal mapping activity conducted during the third series of LAND workshops.

Each section is focussed on one major grouping of causes and contains questions sparked by our observations. Referring to the handouts, please choose an initial area for discussion in your group. Appoint a scribe to make notes. Once you have covered this area, please move on to the next one of interest.

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***Evidence**: Many types of evidence were identified by school teams for demonstrating improved numeracy.*

What are the most useful forms of evidence of student achievement in numeracy at your school? Why? What effect is this evidence having at your school?

***Thinking about Improvement:** 'Evolving improvement' was highlighted as an important cause for improved numeracy:*

What is your school's vision for improved numeracy? How was it developed? What purpose(s) does your vision serve? What does it affect? How do you know?

Why do you think 'evolving improvement' stands out from the other causes listed?

*Perth schools did not have any of their top three causes in the Improvement bubble and the Kimberley schools had nothing in the Organisation bubble.*

Why do you think the two clusters have these different emphases?

***Community**: Students can improve their achievement in numeracy if they are healthy, resilient, attending and engaged. This involves taking steps to ensure students are well served in terms of professional services (e.g. special needs, language support, community health) and parental/home support.*

What steps are underway at your school to ensure these services and forms of support are in place? What is enabling these steps to be taken? What impacts are they having? How do you know?

***Professional Development:*** *Both school clusters listed a number of individual causes in the (PD) bubble but neither placed any of their top 3 here.*

Why do you think this is the case?

What is an example of effective professional development at your school? How is professional development embedded in your school culture? What effect is it having? How do you know?

***Teaching and Teachers:***

*Teachers have a significant 'in-school' effect on student achievement in numeracy – who they are, and how and what they teach. This was evident in the range of characteristics associated with 'Teaching' and 'Teachers', and in the responses to the 'top three causes' question.*

Think of an effective teacher of numeracy at your school:

- What are their most impressive personal qualities? (What type of person are they?)

- What are their most significant professional practices? (How and what do they teach?)

- How is their work (i) influencing and (ii) being influenced by others (students, school colleagues and parents)? How do you know?

***Organisation:*** *Improved student numeracy achievement requires collaboration and supportive organisation and programming.*

What organisational features have been put in place to support improved numeracy at your school? What has enabled these features to be put in place? What are these features affecting most directly?

*The area of 'organisation' had one of the largest number of individual causes listed but only was rated in the top three causes by only one school.*

Why do you think this is the case?