The Visibility of Mathematics to Educators in Pre-school Settings: Case study methodology with mixed methods

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The mixed methods of this case study (to be implemented in 2014) are discussed in terms of the dimensions of mixed or multiple method research as described by Bryman (2006). He suggests five dimensions underpin mixed method typologies and these are used to discuss the mixed method design of this case study. Bryman suggests that multiple methods may lead to multiple surprises and unexpected results. Any method for example the inclusion of photographs may produce unexpected results. It is the researcher's task (in this instance)to create a "thick description" from these mixed methods as an interpretation of the visibility of mathematics to educators inclusive of surprises and unexpected results (Geertz, 1973).

This is a discussion of the proposed mixed methods of my case study, in terms of Bryman's (2006, p. 98) dimensions of mixed methods. The paper begins with description of the context and methodology of the proposed research then explores the quantitative and qualitative mixed methods that will be used to collect the data. Bryman (2006, p. 111) suggests that where the quantitative and qualitative methods of a research study work in tandem, there is the possibility of multiple new insights and understandings. He outlines mixed method research examples that do not work in tandem resulting in surprises and unexpected results. Geertz (1973) suggests that it is in the "thick description" (pp. 310-323), the intellectual ethnographic interpretation that the researcher does of the data, that will produce the insights and new understandings from ethnographic research. My case study includes ethnographic methods as "thick description" or my interpretation of the educator views of mathematics based on a micro analysis of the data. Unanticipated results are part of the richness of ethnographic research methods that become the "thick description".

My questions are:

How do the mixed methods of this case study work in tandem?

Do these methods result in multiple new insights or unanticipated results and surprises?

Before the methods are discussed, the context and methodology of the study needs to be briefly explained.

The Context

This case study is of the views of Victorian educators on the place of mathematics in their pre-school settings. Traditionally the pre-school context has been concerned with the care of children and their learning through play pedagogy. However this education sector is undergoing change (Taylor et al. 2008) including the introduction of state and national programme frameworks: The Victorian Early Years Learning and Development Framework (VEYLDF) (DEECD, 2009) and the Early Years Learning Framework: Belonging, Being and Becoming (EYLF) (DEEWR, 2009). These new frameworks recognise the importance of learning through play but they suggest the need for the inclusion of "intentional teaching" of mathematics (Siraj-Blatchford, 2009) and the views and/or culture of families. It seems an opportune time to find from educators how they view the place of mathematics in their pedagogy and practices. The research question is:

What mathematics is visible to educators in pre-school settings?

The subsidiary questions are:

SQ1 What are educators' beliefs about the place of mathematics in pre-school settings?

SQ2 What mathematics is visible to pre-school educators in the relevant State and National learning frameworks?

SQ3 What mathematics is visible in pre-school educators' practices?

The focus of this research is on finding the range of educator views about the visibility of mathematics in their pre-school setting.

The Methodology

This research uses case study methodology (Yin 2009) within a socio-cultural framework (Vygotsky, 1934, 1986). Case study methodology derives much of its rationale and methods from ethnography. As such its strength is in "thick description" - an interpretation of what the participants say about their reality (Geertz, 1973). Case study methodology interrogates "an instance in action" (Somekh & Lewin, 2005, p. 54) in a "real life context when the boundaries between the phenomenon and context are not clear" (Yin, 2009, p. 18). Case study uses triangulation of data to give validity. Case study like ethnography is criticised for the inability to generalise from the "case", yet the same argument of "thick description" leading to the inquirer's ability to see "transferability" between similar cases, which applies to ethnography, also applies to case study (Lincoln & Guba, 2000).

Case study methodology according to Yin (2009) includes a range of data gathering methods. My case study includes both quantitative and qualitative methods within an overall qualitative design.

The Methods

The study will comprise two phases: a survey (phase one) and individual case studies (phase two). The first phase of the study is an online survey of Victorian degree-qualified pre-school educators. Previous surveys of the views of educators about pre-school mathematics, Thomson et al. (2005) and Hunting et al. (2009)

occurred prior to the introduction of the new frameworks documents (DEECD, 2009; DEEWR, 2009). This proposed survey is timely as it will provide a broad overview of the views of educators since the implementation of these framework documents. Initially the data from the surveys will be analysed for the range of beliefs by educators about the place of mathematics in pre-schools. This range will provide (as far as practicable) the basis of selection of the educators for the individual case studies.

The second phase of the study will consist of six to eight individual educator case studies. These will provide in-depth information about pre-school educators' beliefs about the place of mathematics in pre-school settings.

Discussion of the Mixed Methods

Bryman (2006) suggests that behind the theoretical typologies of multi method research are five dimensions that "draw attention to the different aspects of multi strategy research" (p. 98). Each of these dimensions may apply to all research methods but here they are applied to the mixed methods of this research.
The first dimension is about how the methods are used. Are the quantitative and qualitative data collected simultaneously or sequentially? (p. 98). As previously indicated in the outline of the research phases, the data will be collected sequentially because these quantitative and qualitative methods are interdependent- they work in tandem. The survey is analysed initially to find the range of views educators hold about the place of mathematics in pre-school, then the individual case studies will be of educators who as far as practicable exemplify this range. The challenge will be in finding educators who volunteer as individual case studies and who represent the range of views evident in the survey. An essential aspect of the strengths or limitations of this research will be how effectively the case studies represent the range of views in the survey- how these two methods "work in tandem".

The second dimension of Bryman (2006) is the question of priority given to either quantitative or qualitative methods? Priority in this proposed study is given to the qualitative methods because this research has an overall qualitative design. In both survey and individual educator case studies, examples are sought of educator beliefs, practices and knowledge of the frameworks in mathematics. The quantitative data such as the Likert scales and check boxes in the survey data will be organised and included as descriptive statistics to support the breadth of educator views from the free responses and individual case study data.

The third dimension is the purpose of the integration of these methods. Bryman (2006) suggests this may be triangulation, explanation or exploration. In this research the methods are integrated for the purpose of explanation and triangulation. In the first instance, each form of data will be analysed individually for information about the visibility of mathematics in educator beliefs, practices and knowledge of the new documentation. Then each set of data will be compared for similarities and for exceptions so that the result is a more detailed explanation of this case study. This close analysis and comparison between the varied forms of data will also result in corroboration between these sources, which is triangulation.

The fourth dimension of Bryman (2006) is the stage of the research process that the integration of methods occurs - the question design, data collection, and/or data analysis or data interpretation. For this study, the methods are integrated at the data

collection stage of the research process. The range of educators' views within the survey influences the choice of participants in the individual case studies. These mixed methods are also integrated in the data analysis and interpretation.
The fifth and last dimension of Bryman (2006) is the number of sources of data. A multi strategy or mixed method approach will have more than one source of data. In this study the survey data includes check boxes, Likert scales and free responses. The individual case study data includes field notes, photographs, audio recordings and the collection of artefacts.

This analysis of the proposed methods against Bryman's (2006) dimensions suggests that these proposed methods are interdependent and integrated on a number of levels within an overall qualitative design so they should "work in tandem". The bigger question is whether anticipated or unanticipated results will be included.

Bryman (2006) suggests that mixed methods research combines neatly in theory but produces surprising findings or unanticipated outcomes in practice. This may occur in the results of this case study as it is yet to be implemented. However each collection of data alone such as the inclusion of photographs raises the possibility of multiple surprises and unanticipated possibilities. In my understanding of Geertz (1973) my task is to explore "the multiplicity of complex conceptual structures, many of them superimposed or knotted into one another, which are at once strange, irregular and inexplicit… grasp [them] and render [them] intelligibly" (p. 314)as the range of views of mathematics by educators. Both unanticipated and anticipated results will be integrated as "thick description". Photographs will potentially provide unanticipated results.

Photographs as a data source

Photographs supported by field notes and audio recordings are used for several different purposes in the individual case studies. Gold (2007 cited in Stanczak) suggests they are useful for orientation purposes of the researcher. In each of the case studies photographs will document the layout and resources of the pre-school setting. In addition they will document the educator's practices in mathematics and be the focus of discussion in the interview.

The choice to include photographs as an observation and documentation tool stems from their current use by educators. Kline (2008) in her discussion of the "document panel" identifies the centrality of observation and documentation for pre-school educators as does Carr (2001) with the "learning story".

Ruto-Korir and Lubbe-DeBeer (2012) included photographs and found that rapport with participants developed when photographs were delivered by email as a form of "power-sharing" with participants prior to interviews (Gubrium & Holstein, 2003 cited in Ruto-Korir & Lubbe-DeBeer 2012). Gold (2007 cited in Stanczak 2007) agrees with this process. He suggests that photographs also assist researcher orientation, and improve analysis. However Goldstein (2007 cited in Stanczak) suggests photographs have limitations as they capture only "a brief moment in time" (p. 12) are subjective and not representative of the whole reality. He still favours their use as a visual element in addition to text. In my case study they are not intended to represent all reality instead they will be drawn on to assist educator explanation of mathematics in her setting.

These multiple purposes behind the choice to include photographs suggest that this one data source may produce complex or deep or unanticipated results or all of these. It is from the analysis and cross comparison of all these sources of data that the "thick description" (Geertz, 1973) of this case study will eventuate.

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