Variety of methods (1) for conducting research

David F Treagust School of Education 26.04.17
Organisation of the talk

- What Is a Paradigm?
- Paradigms and guidelines for data collection methods
- Positivist research paradigm
- Interpretivist research paradigm
- Critical theory research paradigm
- Pragmatic research
- Types of data sources
- Strengths and weaknesses of data collection methods
- An example of my own work
What Is a Paradigm?

- A way to view the world
  - a world view, or framework that guides research and practice in a field
  - Different belief systems lead to different understanding
- A set of basic beliefs in relation to
  - Ontology (reality—what is real?)
  - Epistemology (knowledge—what do we know and how do we know it?)
  - Methodology (methods—how do we obtain knowledge?)
- 3 major paradigms in educational research
  - positivist, interpretivist, and critical theory
  - Within a paradigm, there can be a variety of data collecting approaches.
Paradigms and guidelines for data collection methods

- Placing studies within a particular research tradition or paradigm gives researchers philosophical, methodological and practical guidelines to design and conduct research.

- Tendency for positivist researchers to use quantitative data sources.

- Tendency for interpretivist and critical theory researchers to use qualitative data sources.

- Mixed methods researchers combine quantitative and qualitative data sources in various ways.
Positivist research paradigm

- **Aim** – provide a rational explanation for a phenomenon – often linked to efficacy or effectiveness of a program or project

- **Philosophy/Theory** – objective using scientific methods of enquiry, distant spectator, naïve realism

- **Research questions** - asks whether? or how much?

- **Designs** – Formal designs with comprehensive sampling

- **Role of the researcher** – reporting phenomena without bias

- **Theory verification** - tests hypotheses

- **Quality Standards** – reliability and validity

- **Data** are quantitative or are quantifiable; statistical analysis
Interpretivist research paradigm

- **Aim** – focus on social construction of meanings
- **Philosophy/theory** - Relativist ontology and constructivist epistemology; grounded theory
- **Asks research questions** - what, why and how?
- **Designs** - Adopt qualitative research designs – case study, ethnography, narrative, phenomenology
- **Role of the researcher** – sense maker and narrator
- **Quality standards** - trustworthiness and authenticity
- **Theory generation**
- **Data are mainly qualitative** – lengthy transcripts or rich verbal descriptions of discourse. Multiple participant meanings
Critical theory research paradigm

- **Aim** – focus on inequality and power dynamics in human interactions – research will transform society

- **Philosophy/theory** – social theory oriented towards changing society, historical realism, problematising a situation

- **Asks research questions** - what, why and how?

- **Designs** – similar to interpretive studies - action research

- **Role of the researcher** – challenging society, critical autoethnography, critical reflexivity

- **Quality Standards** – explicitly discuss biases of researchers

- **Data are qualitative or can be quantifiable**
Pragmatic research

- Mixed methods research not committed to any particular paradigm or perspective on the nature of knowledge or reality
- Many designs – see Creswell books
- Use qualitative research to help explain quantitative findings
- Explore using qualitative research and then generalize findings to large population using quantitative research
Types of data sources

- **Quantitative Data**
  
  - Questionnaires – established constructs, eg Motivation, Field Dependence-Field Independence, Test of Logical Thinking
  - Attitude instruments – eg Attitudes to science, to chemistry
  - Diagnostic tests – eg conceptual understanding
  - Behavioural checklists - eg monitoring actions in the laboratory

- **Qualitative Data**
  
  - Interviews – structured, semi-structured, open-ended
  - Focus groups – eg uses group synergy to identify perspectives
  - Observations – eg., of students actions in a laboratory
  - Audio-visual materials – eg, of lessons, museum visitors
  - Self-reflection – action conversations
  - Document analysis
Strengths and weaknesses of data collection methods - Questionnaires

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Efficient for routine data with large N</td>
<td>Non-responses, questionnaire fatigue</td>
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<tr>
<td>Quantitative analysis – descriptive and inferential analysis</td>
<td>Needs extensive planning and pre-testing the instrument</td>
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<tr>
<td>Can use a large number of questions</td>
<td>Danger – people do not understand the questions – response bias</td>
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<td>Can also obtain individual comments</td>
<td>Data entry errors if transferring from paper to electronic file</td>
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# Strengths and weaknesses of data collection methods - interviews

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Shows value of the individual</td>
<td>Personal nature may lead respondents to please rather than be truthful</td>
</tr>
<tr>
<td>Allows for in-depth analysis and follow-up questioning</td>
<td>Requires careful planning of questions and interview training</td>
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<tr>
<td>Most people agree to be interviewed</td>
<td>Logistical issues around the interview</td>
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<td></td>
<td>Time consuming and expensive</td>
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Some examples of data collection from some of my own research

- Diagnostic tests – carefully designed conceptual questions
- Interpretivist paradigm
- Research field – alternative conceptions
The Kinetic Particle Theory Diagnostic Instrument (item 5- Intermolecular Spacing)

The diagram shows a pump containing a coloured gas that is compressed by pushing the plunger down.

We can conclude that

A the volume and mass of air in the pump have decreased.
B the volume of air has decreased while the mass has increased.
C the volume of air has decreased while the mass remains constant.

The reason for my choice of answer is:

1. Gas particles can be readily compressed and pushed closer together.
2. The widely-spaced gas particles have been pushed closer together.
3. The number of gas particles has decreased.
Development of Two-tier Diagnostic Test Items

Three major data collection methods to develop these items:

• **Content analysis** and writing propositional statements to define the content which is then represented in a concept map
  – so as clear as is possible about what is being assessed

• Information about students’ conceptions is obtained from
  - extant research literature
  - **students’ free response** explanations to first tier
  - conducting **unstructured interviews** with students who have been taught the content/concepts

• The development of the two-tier multiple-choice diagnostic items
Chemical Bonding Diagnostic Test (item 1)

Sodium chloride exists as a molecule.

I  True  II  False

Reason:

A  The sodium atom shares a pair of electrons with the chlorine atom to form a covalent bond.

B  The sodium ion forms a molecule with the chloride ion.

C  Sodium chloride exists as a lattice consisting of sodium ions and chloride ions.

D  Sodium chloride exists as a lattice consisting of covalently bonded sodium and chlorine atoms.
Students’ responses to Item 1 of the *Chemical Bonding Diagnostic Test* (Australian Year 11, n = 170)

<table>
<thead>
<tr>
<th>Choice to first part</th>
<th>Reason</th>
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<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>I</td>
<td>22.5</td>
</tr>
<tr>
<td>II</td>
<td>1.0</td>
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</table>
Common alternative conceptions of chemical bonding held by 15-16 years old students \((N = 119)\)

<table>
<thead>
<tr>
<th>Alternative conception</th>
<th>Choice combination</th>
<th>% of students with alternative conception</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bonding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metals and non-metals form molecules</td>
<td>Item 1 [1]</td>
<td>80</td>
</tr>
<tr>
<td>Metals and non-metals combine to form molecules consisting of oppositely charged ions</td>
<td>Item 1 [1B]</td>
<td>46</td>
</tr>
<tr>
<td>Atoms of a metal and a non-metal share electrons to form molecules</td>
<td>Item 1 [1A]</td>
<td>23</td>
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Summary

I have attempted to show

- How placing studies within a particular research tradition or paradigm gives researchers philosophical, methodological and practical guidelines to design and conduct research.
- Described a variety of methods and some of their strengths and weaknesses
- Provided an example from my own work
References