Variety of methods (1) for conducting research

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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 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

Strengths	Weaknesses
Efficient for routine data with large N	Non-responses, questionnaire fatigue
Quantitative analysis – descriptive and inferential analysis	Needs extensive planning and pre-testing the instrument
Can use a large number of questions	Danger – people do not understand the questions – response bias
Can also obtain individual comments	Data entry errors if transferring from paper to electronic file

Strengths and weaknesses of data collection methods - interviews

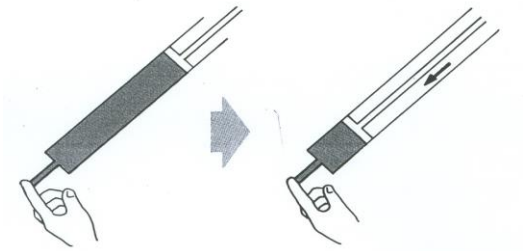
Strengths	Weaknesses
Shows value of the individual	Personal nature may lead respondents to please rather than be truthful
Allows for in-depth analysis and follow-up questioning	Requires careful planning of questi0ns and interview training
Most people agree to be interviewed	Logistical issues around the interview
	Time consuming and expensive

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.

4. Other

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)

Choice to first part	Reason			
	A	B	C	D
I	22.5	46.1	7.8	3.9
II	1.0	1.0	16.7*	1.0

Common alternative conceptions of chemical bonding held by 15-16 years old students (N = 119)

Alternative conception	Choice combination	% of students with alternative conception
Bonding		
Metals and non-metals form molecules	**Item 1 [1]**	**80**
Metals and non-metals combine to form molecules consisting of oppositely charged ions	**Item 1 [1B]**	**46**
Atoms of a metal and a non-metal share electrons to form molecules	**Item 1 [1A]**	**23**

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

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