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Guidelines for using video to study workshop or workplace-based trades learning

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Contents

Introduction 5

What is research? 7

Becoming a teaching practitioner/ researcher 7

The Research Process 11

1) Identify the research topic 12

What happens before the research begins? 12

What are research approaches? 13

2) Review the literature 16

How to conduct a literature review 16

Link research to pedagogical assumptions / relevant learning theories 17

3) Clarify and justify the research questions and methods 19

Identify and address ethical issues 20

Requirements for undertaking research with students / apprentices 20

Specific requirements for workplace-based research 21

Specific requirements for multimodal discourse analysis 21

4) Identify the methodology 23

Match research methods to research question/s 23

What is multimodal discourse analysis? 23

Deciding to use multimodal analysis 24

5) Gather and record data 25

Collect evidence / data with videos / voice recorders 25

Why and how to use research journals 26

6) Analyse and interpret findings 28

Multimodal discourse analysis protocols 29

Completing qualitative analysis with and without qualitative analysis software 30

Establish validity, reliability and perhaps generalisability 33
7) State conclusions 36
Collate findings into a coherent report 36
8) Record references 38
9) Report research 39
Identify methods for appropriate dissemination of study 39
Identify methods for appropriate application of study 39
Bibliography 41
Appendices 43
Sample report 43
Research terms – hierarchy 53
Template for literature review summary 54
Annotated bibliography of useful readings and references 55
Sample information letter 59
Sample consent form 61
Example of video transcription 62

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"Ko nga kaihanga whare, ka riro ma te whare ano ratau e hanga."

"*Those who build the house are built by it.*"

Attributed to a Maori elder and translated by Professor Wharehuia Milroy

Disclaimer: **Note that although the guidelines have been generalised to carry out multimodal discourse analysis using video as the primary data collection tool, these guidelines have been compiled through work carried out within two specialised contexts. These are (i) study of the learning of welding by two groups of full-time students studying at a New Zealand Polytechnic and (ii) project undertaken to study the interactions between apprentices and their trainers on building worksites.**

Introduction

This guide is written to help teachers /workplace trainers build capability to study the learning of trades-skills and knowledge by students or apprentices in classrooms, workshops or in the workplace using a specific research methodology.

This guide is presented as a **'how-to-do' manual**. It may be used in conjunction with a series of workshops and/or elearning course, to learn how to use videos and the multimodal discourse analysis method to study how students learn. This guide provides:

- recommendations for *collecting data* using video and voice recorders while students or apprentices are engaged in real-world/situated learning or work activities.
- instructions on how to *set up a project* using the multimodal discourse analysis approach,
- direction on how to *analyse data* collected and
- guidance on *collating the findings* into a report .

One of the reasons for producing this guide is to introduce the use of multimodal discourse analysis research methodology. This research method is a relatively new but skill intensive form of research (Erickson, 2006), that is useful for studying and understanding learning.

Multimodal discourse refers to the study of the various methods used by humans to communicate (the discourse) including using voice, writing and 'body language'(the multimodalities). *Multimodal discourse analysis* details the processes used to scrutinise video data by studying the context and participants' communications and interactions with others (both verbal and non-verbal).

Careful examination of video data may reveal aspects of learning not easily obtainable by other data collection methods (Erickson, 2006). Findings can then be applied towards enhancing the development of better learning opportunities for learners. This guide is compiled to provide an introduction to a research process that uses current technology (i.e. digital videos, digital voice recorders and data analysis tools) to investigate real-world activities.

Recommendations within this guide are derived from the learning and experiences from ongoing projects carried out at Christchurch Polytechnic Institute of Technology (CPIT) to study how students or apprentices learn trade skills. To provide background to the contents in this guide, an example of one project (Learning welding: Improving the learning of welding using peer-learning and feedback), is included in Appendix 1 of this report. Other examples worth studying are the work of Nuthall (2007) and de Saint Georges and Filliettaz (2008).

Additionally, examples from the projects used to help construct the guidelines provided in this report are detailed in boxes. These examples are used to help explain research concepts and model academic writing relevant for preparing research proposals and reports.
Here is an example:

Two research projects were undertaken to evaluate the suitability of multimodal discourse analysis. One examined the learning of full-time students as they attained welding skills, the other investigated the interactions between apprentices and their trainers as apprentices learned practical skills on building worksites.

☺ Hints and pertinent recommendations made by the authors on research practice are marked with smiley faces ☺

For instance:

☺ A suggested sequence to reading this guide is to

- firstly skim read the document, without reading the boxed examples.
- secondly, read the report in Appendix 1 to provide an example for the type of research this guide introduces.
- Thirdly, undertake a more thorough reading of sections of this guide as required ☺

The above recommendations are directed to readers of this guide who are new to the research process. If you are an experienced researcher, you might like to mine this guide for specific recommendations on using the multimodal discourse methodology. Details for conducting multimodal discourse study are found in Sections 5, 6 and 7**.**

What is research?

This guide is designed to assist teachers /workplace trainers, who are interested in learning more about their teaching practice and finding out how their students learn, by introducing **one research approach**.

For the purposes of this guide, research is defined as

> "a way of making sense of experiences and the world about us in a systematic way. It is a method of problem solving that leads to an increase in knowledge on a specific topic or issue." (Christchurch Polytechnic Institute of Technology [CPIT], 1996 p. 1.2)

There are many ways to conduct research. This guide details **one method** used to gather *primary evidence* of student or apprentice learning. In this method, primary data or evidence from students or apprentices involved in learning activities is gathered using videos and voice recorders. *Primary data* records *actual evidence*. In comparison, secondary data is gathered using interviews, questionnaires, narratives, learning journal etc.. Secondary data records evidence filtered through research participants' (i.e. the people being studied) perspectives. Therefore, as defined in some approaches to educational research, primary data is a record of actual events as they take place whereas secondary data is gathered of what participants think may have occurred (Anderson, 1998).

☺ This guide will NOT cover methods of secondary data gathering ☺

However, secondary data gathering methods may still be useful, where required, to support findings generated through research methodology covered in this guide.

Becoming a teaching practitioner/ researcher

☺ It is not the purpose of this guide to be a definitive text on research methods ☺

Several recommended resources are listed in Appendix 4, including books by Gobo (2008), Mutch (2005) and Wellington (2000). Additionally, the Ako Aoteoroa website has several good resources which will help you obtain foundational understanding of the research process. In particular, a good series of resources, explaining the research process is found at

http://akoaotearoa.ac.nz/ako-hub/ako-aotearoa-central-hub/news/research-roadmap

☺ The resources listed above will be helpful as you travel the research journey ☺

This guide is specifically produced to help teachers or workplace trainers start using videos and voice recorders as a form of data collection. In particular,

- Evaluate if the use of videos or voice recorders will be appropriate for data collection and
- how to *analyse* the information collected to help understand how learning occurs in practical workshop or workplace-based learning settings.

The use of video allows for collection of primary evidence / raw data of skills learning and the interactions students have with others. This data is especially useful as it

- is generally *non-intrusive*. The recording is of students and the people they interact with as 'normal' activities are conducted within 'typical' learning environments.
- allows for *nuances of learning* to be collected, in particular for forms of kinaesthetic learning, tacit knowledge (skills or techniques experts use intuitively but may not be aware of) and learning interactions to be collected without filtering through participant's perspectives, as with interviews, questionnaires or learning logs, whereby students report on how they learn a skill.
- does not rely on *novices to articulate concepts and learning*. Learners may struggle to explain as they are beginners, learning a skill or concept.
- collects *real-life experiences*. The use of video provides opportunities to collect, record/archive and examine in greater depth, authentic and situated learning occurring in real-world settings.

  (Heath & Hindmarsh, 2002)

☺ The research terms in this section will be explained progressively through this guide ☺

In our experience, becoming a researcher requires a commitment to learn about:

- perspectives from which a research study will be developed. For instance, will it be mainly a quantitative or qualitative study? What research paradigm (positivist, interpretivist, critical) will underpin the study?

- method /methodology used in the research. For example, is it based on case study, ethnography, action research?
- research tools available. In this guide, the main research tools are videos and voice recordings to gather data and recommended data analysis procedures using qualitative analysis software to find answers to research questions.
- reporting techniques for research. Will a report or paper need to be written or will the findings be presented verbally? What or who will be the audience for the dissemination of research?
- concepts of research validity and reliability and to argue how a project meets these requirements.

In addition, it is important for you to acquire and apply academic skills required to engage with educational research literature and write reports to distribute research findings. Therefore, the authors encourage you, if you have not already done so, to complete an undergraduate course on educational research methods at level 6 or 7. The course should cover the topics listed above but will also help you increase familiarity with research jargon and begin building networks with other new researchers. The opportunity to engage with research discourse will also be helpful for undertaking critical reading of research articles or literature.

By attaining research expertise, you will be able to consolidate many of the experiences and skills of an effective and critically reflective teacher and researcher. These include

- specialised knowledge and experience of discipline / craft / trade practice,
- experience and learning about teaching a specialist subject,
- understanding of how students best learn within a discipline / craft / trade,
- work-related operational and interpersonal skills
- life experiences as parent and / or coach / mentor in various non-work related activities,
- curiosity as individuals.

Your commitment to become a teacher / workplace trainer who undertakes research, provides rich rewards, both for yourself and your students / trainees. Research may provide some empirical answers to you, as teachers, about students' learning and the effectiveness of teaching practice. Practitioner research may assist with illuminating good teaching practice which has become intuitive, leading to increased insight about teaching and learning processes (Mutch, 2005). Research based findings may form the basis for leading change in practice, curriculum design, teaching delivery etc. through application of evidence based recommendations.

☺ The next section will cover each step in the research process ☺

The Research Process

There are many approaches to research. In this guide, a brief introduction to TEN basic steps of research (CPIT, 1996) is used to introduce the research process.

These are:-

1. **Identify the research topic**
2. **Review the literature**
3. **Clarify and justify the research questions and methods**
4. **Identify the ethical issues**
5. **Identify the methodology**
6. **Gather and record data**
7. **Analyse and interpret findings**
8. **State conclusions**
9. **Record references**
10. **Report the research**

Each of the above steps is now discussed in general terms. Remember, this guide has been written with reference to the specific context of multimodal discourse analysis, which is a specialised form of conducting research. Therefore, although many of the principles provided in this guide are common to other research methods, be careful not to generalise all the recommendations in this guide to all research projects.

☺ If in doubt, check with other experienced educational researchers ☺

1) *Identify the research topic*

Before you can begin any form of research, the first objective is

- to identify and complete a preliminary study of the research topic and
- match the topic to relevant research approaches or paradigms (Wellington, 2000)

☺ From undertaking this exercise, you will establish connections between research questions and appropriate research methods to carry out the investigation ☺

What happens before the research begins?

Here are some ideas to help you narrow the research focus:

- Talk to your students. Are there areas of study they find difficult?
- Have on-going informal conversations with your teaching colleagues. Is there something about teaching which the section is interested in investigating?
- Check-in with non-teaching staff. Technicians and allied staff often observe teaching and learning situations and may notice practices the teacher may not be aware of.
- Read articles about teaching or research specific to the subject area.
- Brainstorm ideas, perhaps gleaned from reflections on teaching practice, and update the list regularly.

As an example, the genesis of the projects used to build these guidelines is described here:

For many years, the work of the late Dr. Graham Nuthall on 'the hidden lives of learners' (Nuthall, 2007), has been an inspiration to educational researchers. This work, undertaken using the technology available in the 1980s and 1990s, assisted with understanding the minutiae of students' interaction with their peers, teachers and school environment as students engaged with classroom teaching and learning activities. Recent work by University of Victoria's Dr. Janet Holmes (2006) and her team on communications in workplace settings, and University of Geneva's Dr. Laurent Filliettaz (de Saint-Georges & Filliettaz, 2008) on apprentice learning in formalised institutional environments, has provided more up-to- date techniques for garnering and analysing data from actual workplace and polytechnic-based learning situations. The advent of digital technology has also been accompanied by the need to study human interactions using a broader research approach. This

approach may provide better opportunities to understand the role of multiliteracies (New London Group, 1996) and multimodal interactions (Salonen, Lepola & Vauras, 2007), both of which take place when people communicate and inter-relate with each other.

In the above, the connection between using primary data collection tools (videos and voice recorders), as utilised by Dr. Graham Nuthall's research team, is linked to contemporary approaches to learning, encouraging recognition of the different ways in which people learn. Therefore, from the outset, the above project had a clear objective, to try to better understand how individuals learn a trade as informed by current understandings of the learning process.

Here is another example, from one of the projects used to inform the writing of this guide. This excerpt is condensed from our research journal.

During the initial study in a practical welding workshop, we observed students viewing detailed practical demonstrations by skilled welding tutors, followed by students' practice of welding skills. One aspect of the welding workshops' configuration is the utilisation of welding booths. These are constructed to contain individual students' welding activities as welding generates bright light arcs, sparks and heat. Consequently, students' learning becomes dependent on individualised learning and students are unable to share their immediate learning experiences with other students. Therefore, this project was conceived to investigate the advantages of allowing students to work in pairs, whilst learning welding, in particular, to find out if peer-learning opportunities for students would lead to enhanced acquisition of welding skills.

What are research approaches?

☺ This section introduces and discusses some foundations of the research process. You might like to return to this section again later, to form connections between this section, research approaches, with Section 3 - Clarify and justify the research questions and methods and Section 5 – Identify the methodology ☺

The research approach or theoretical stance you choose to underpin a study has important consequences on how the study is carried out, the research methods and tools selected and how findings are eventually reported (Mutch, 2005).

In this guide, a simplification of research approaches is to use three theoretical stances. These are positivist, interpretivist and critical approaches (Mutch, 2005). A very brief summary of each follows:

- *Positivist and post-positivist* – use organised processes to deduct or discover and propose hypothesis and then tests variables to confirm these hypotheses as theories. In order to control variables, positivist-based experiments are carried out in laboratories.

- *Interpretivist* – assume there is no one answer and use systematic research methods to try to understand people, conducting activities in a natural setting real-world context. The data collected is then interpreted, using a variety of theoretical lenses to illuminate human society.

- *Critical* – adopt a critical inquiry process, often with involvement from both researchers and research participants, to try to solve problems which help change people's lives.

By selecting one of the above approaches, some direction may be obtained on whether to collect and analyse data, quantitative or qualitative. Each of these is now briefly discussed.

- *Quantitative* – Although a quantitative research stance is related to positivist research approaches, some of the research tools and methods used by positivist researchers are useful for some aspects of understanding how people learn. For instance, demographical data (e.g. age, gender, prior experience etc.) can be effectively and efficiently collected using structured questionnaires. The results from questionnaires are often helpful for providing background to how to analyse data using qualitative methods. Analysis of video data may also use quantitative approaches whereby frequencies (i.e. how many times) and quantities (i.e. how much) are collated during data analysis. Examples of quantitative research studies are found in Hattie's (2009) book. This book reviews and evaluates thousands of quantitative studies, collated into over 800 meta-analyses, to collate important factors which contribute to students learning.

- *Qualitative* – A commitment, to use either the interpretivist or critical approaches to carry out research projects, means adopting a mainly qualitative stance when collecting and then analysing data. In qualitative research, quantitative measures like frequency (i.e. how often) or other measurements (i.e. time duration etc.) may still be useful. However, the main technique used is to distil themes (i.e. thematic analysis) from the data. This implies study of data (e.g. watch, take notes, work with

transcripts etc.) to establish if there are common ‘threads’ or themes emerging from data. For example, when working on interactions between apprentices engaged in peer learning activities, some themes that emerge might be the quality and depth of peer conversations specific to learning a concept or skill. The report provided in Appendix 1, is an example of a study undertaken using qualitative approaches.

To assist with linking the various concepts of research approach, the research purpose, orientation and examples of how they are conducted in the form of method, research tools and reporting, is provided in diagrammatic form in Appendix 2.

Note in the diagram in Appendix 2, how each research approach (positivist, interpretivist, critical) has preferred research orientations, methodology, instruments or tools, data /artefacts and reporting styles. These are **recommended interconnections** and there may be ‘cross-pollination’ between research approaches. However, the diagram provides a *simplified* visual representation of the associations between research approaches and how the adoption of a specific research approach, directs the research process.

☺ The concepts discussed in this section also contribute towards ensuring your research study will be valid and reliable and perhaps generalisable. These concepts are discussed in greater detail in Section 7 – Analyse and interpret findings ☺

2) *Review the literature*

Once a worthwhile topic to research has been decided, it is important to find out what work has already been completed. Make use of your library databases and/or librarians to help find material relevant to the topic. The first reading of the literature will be to find out if there is a 'gap' in the existing literature which warrants further research. Most research arises because no one else has undertaken a similar, structured approach to examining the issue. Even if the intended topic you decide to explore has been well-researched, other aspects including the context (e.g. New Zealand/ bicultural, research participant profiles, specific trade, workplace organisation) might be sufficiently different to warrant another investigation. Therefore, when you begin a formal research project, it is important to be able to justify, with support from pertinent literature, why the research needs to be undertaken (Mutch, 2005).

How to conduct a literature review

While you carry out the initial literature search, sort the literature to identify the most important pieces of work relevant to the topic. On the second reading, of the now sorted and selected literature, try to find out how other researchers have conducted their study. This provides information on how other people have completed research in the topic and may offer direction on how to approach the study (CPIT, 1996).

As literature is collected, ensure a current bibliographical list is maintained. Use a structured approach to

- *detail* each piece of literature using the correct referencing convention,
- briefly *summarise* the article's purpose and findings
- *identify* parts of the article which are relevant to the project
- *explore* other articles cited by the author/s that may be important also to review.
- *compare* the research approaches, methods and theories adopted to undertake research.

To assist, a template is provided in Appendix 3. The headings for the table can be changed to fit your project.

☺ Details of the literature can also be stored on a digital database. An example is the bibliographical software package called Endnotes, which allows linkage between the Endnotes database and Microsoft Word. When integrated with Word, Endnotes allows the Endnotes database to be searched from within Word and generate a bibliography / reference list ☺

Adopting a structured approach to the initial literature review will make it easier for you to

- find out the methods, research approaches, pedagogical assumptions and references others use,
- make connections between the proposed project and existing work,
- evaluate what others have done and how to contribute to more learning about the topic,
- provide support for findings,
- write the research report.

In this guide, a list of **useful readings and references** are provided in Appendix 4. These references are listed with the *American Psychological Association (APA) referencing convention* and were used to inform the projects that contribute to the construction of this guideline.

☺ The references provided in Appendix 4 are in the form of an *annotated bibliography*. This means comments are included for each article. This is to help build familiarity with selected literature on researching skill-based learning ☺

Link research to pedagogical assumptions / relevant learning theories

All research needs not to only be founded on a strong research approach (i.e. positivist, interpretivist or critical) but the project itself should also add to existing knowledge. Hence, the need to conduct a literature review, as described in the section above.

A review of the literature on the topic to investigate will also provide some direction on

- what others have done,

- what approaches have been used
- the theories underpinning their project and
- what still needs to be found out.

Therefore, it is important to establish the theory foundation or pedagogical stance / assumption for the research project (Mutch, 2005). This will depend on the topic to be investigated. For instance, the following example is provided.

There is an undeniable progression of society in the form of personal working, public and private lives (New London Group, 1996) which have changed the way in which we live, work and play. Technological changes as evidenced in research on Generation Y (Sheahan, 2005) include many calls for changes to the way in which educational institutions provide learning opportunities (Weigel, James & Garner, 2009; Hodkinson, Biesta & James, 2008).

Over the last two decades, research into workplace learning has revealed the workplace as a challenging environment (Billett, 2001) for undertaking 'expansive learning' (Fuller & Unwin, 2003). Apprentice completion of National Certificates, where much of the learning and assessment is undertaken in the workplace, has also been low, averaging just over 30% after five years in an apprenticeship with a range of 0% to 65 % across 30 trades (Mahoney, 2009). The two trades to be studied in this project have completion rates of 28% for building and construction and 42% for engineering (Mahoney, 2009). A better understanding of how apprentices learn skills in on (Rex, Steadman and Graciano, 2006) and off-job environments is therefore required.

In the above box, some of the pedagogical foundations for the projects undertaken and used to construct these guidelines are presented. Included in the above would also be the *role of multiliteracies (New London Group, 1996) and multimodal interactions (Salonen, Lepola & Vauras, 2007)*.

The examples above provide some direction for undertaking a project. The articles cited also provide a resource from which to understand the work of other researchers and how the current project may contribute new understanding/knowledge. The choice of pedagogical foundation for your project may follow a different route from the examples provided.

☺ It is important to become familiar with the literature of the chosen approach and to be able to justify why certain learning theories or research approaches have been selected. These provide an 'anchor' for your work ☺

3) *Clarify and justify the research questions and methods*

A clearer focus on the project research question can be formulated from the work (as described in the above section) by deciding on a research topic and completion of a literature review. The establishment of one or several research questions is important in all forms of research (Mutch, 2005). It is especially important in qualitative research to set boundaries or parameters for each research project as it is very easy to collect a large amount of data and then find it difficult to focus on finding answers which will be useful (Strauss & Corbin, 1990). This is especially the case when using videos to collect data. The temptation is to collect a large amount of footage (Erickson, 2006). This means you may become overwhelmed by the volume of data generated!

For example, in one of the projects used to help build these guidelines, one method was to

- Identify 'learning outcomes' or competency 'elements' to study.

An example of how this is used follows.

A first step will be to identify the types of learning expected of students in order to be able to competently adjust welding equipment. This is to be accomplished through analysis of unit standards and learning outcomes in courses descriptors and informal focus group meetings with welding tutors (to obtain tacit learning). These learning outcomes (specific propositions, definitions, concepts, explanations, principles and generalisations & procedures) form the categories for observations and analysis of the data collected.

Identify and address ethical issues

☺As researchers, ethical practices are important and MUST be followed ☺

Three ethical standards which are of importance are beneficence, respect for human dignity and justice (CPIT, 1996). In general, ethical issues revolve around principles including

- treating all people with respect (Aroha kit e tangata),
- sharing knowledge (manaaki kit e tangata) and
- not trampling on the dignity of people (Kaua e takahia te mana o te tangata) (Smith, 2005).

Some of the accepted ethical considerations, as related to educational research (Mutch, 2005) are now discussed. To assist with understanding ethical issues, examples of an information letter and a consent form are provided to reinforce the ethical requirements presented in this section.

Examples of an information letter and consent from, covering some of the specific ethical issues relating to the use of videos and voice recorders, is provided in the appendices. Appendix 5 for a sample information letter and appendix 6 for a sample consent form.

Requirements for undertaking research with students / apprentices

- *Informed consent* – research participants must be informed about the aims and methods of the research project including their rights as participants.
- *Voluntary participation* and right to withdraw – participants' rights to not participate or to withdraw part way through the project must be respected.
- *Permission* – must be sought for all aspects of the project which will involve participants.
- *No coercion / deception* – there must be no pressure placed on participants to agree to participate. All information about the project should be made available to research

participants before the beginning of the project, whenever any changes are made to the research process or when participants request more information.

- *Confidentiality* / Anonymity / Privacy – all participants' information must be kept confidential including names of participants, their course, workplace, employers and workmate names. Anonymity may be ensured by using pseudonyms or assigned coding to replace aspects of participants' details. Primary data (e.g. videos, voice recordings) and secondary data (e.g. transcripts) must be stored in secure areas (e.g. locked filing cabinets / cupboards, pass-word protected computers) and only accessible to researchers. If primary data (e.g. videos, photos, audio files) is used in presenting research findings, the participant's identity must be protected through removal of any references to individuals or 'blurring' of participants' features.

- *Participants' safety* – ensure proper safety processes in workshops and workplaces are not compromised during data collection.

- *Researchers' safety* - Researchers should collect data from unobtrusive but physically safe positions in classrooms, workshops or workplaces. In some cases, researchers may have to obtain safety clearance from institutions or workplaces before collection of workplace data may proceed.

  ☺ This might require completion of training programmes or unit standards on worksite safety or similar ☺

- *Dissemination* – research data (e.g. video clips, photos, voice recordings, video or voice transcripts) excerpts used in reports, journal articles or presentations, must not reveal participants' identity.

Specific requirements for workplace-based research

All as mentioned above with emphasis on permission, participant and researcher safety.

Specific requirements for multimodal discourse analysis

As listed in the two sections above with emphasis on voluntary participation, right to withdraw, permission, confidentially, anonymity and privacy.

Do ensure you are familiar with and follow specific institutional or organisational ethical requirements of research. Generic ethical guidelines are also available through research discipline specific organisations exampled by:

- The American Psychological Association (APA) http://www.apa.org/ethics/code/index.aspx

For instance, the projects undertaken to help prepare these guidelines required each research proposal to be scrutinised by an ethics committee. The research proposals included a clear description and justification of the research method and production of research participants' information letters and consent forms.

4) Identify the methodology

Match research methods to research question/s

As described in the section on research methods, it is important to match the research approach to types of data to collect and how to analyse data. For example,

Selected skill-based learning outcomes will be deconstructed to identify focus of study. Data of apprentices' learning will be collected using video cameras and voice recorders. This data will be analysed using multimodal discourse analysis methods.

In any research, it is always important to identify the 'unit of analysis'. 'Units of analysis' is the name researchers give to the 'items' or 'variables' to be studied / investigated or researched (Strauss & Corbin, 1990). In one of our projects, the following were identified as 'units of analysis'

In the project studying how full-time pre-trade students learn welding, the units of analysis are the ***students****, the* ***interactions they have with their tutor*** *and the* ***interactions they have with their other students (peers).***

The above means that when we collect the data, we focus on the various interactions (units of analysis) of students, student with tutors and students with students. During data analysis, the various interactions (verbal and non-verbal) are 'deconstructed' (each part and aspect of the interaction is studied) to obtain meaning from why, how, when and what occurs.

What is multimodal discourse analysis?

Multimodal discourse analysis is a research methodology which is relatively new (Erickson, 2006). Using multimodal discourse analysis involves firstly collecting some form of research data, usually in the form of *videos of people undertaking some activities*. Multimodal data may also include the collection of other types of data or research artefacts, including *written materials* (e.g. student workbooks, worksheets, practical assessment check-sheets, written assessments), *audio recordings* of conversations, *interviews* which are recorded and transcribed, *questionnaires* etc. (Erickson, 2006).

The main research data collected is video data as this provides the opportunity to record not only what people say but what they do and their interactions with other people, including collecting non-vocal signals (Burgoon, 1994). Therefore, videos provide a rich source of primary data, useful for examining how students learn trade skills. For example, reasons for using video in one project is provided in the following,

This is especially important when much trades-based learning is undertaken in 'noisy' workshop or workplace environments or where the process (e.g. welding) requires the activity to be undertaken in a specialised layout (e.g. welding booth) which makes it difficult for the learner to interact with other learners.

Deciding to use multimodal analysis

☺ Due to the time consuming and sometimes complex nature of deploying multimodal analysis methods, the decision to use this methodology must not be taken lightly ☺

However, if a study involves the need to gather evidence of human activity as it is conducted in a real world setting, employing video and voice recorders to collect data and then using multimodal discourse analysis techniques to study the data, may yield findings applicable to solving real-world problems.

The decision to select the multimodal analysis method to carry out your research project may arise from

- indications or recommendations derived from the literature review
- the research approach the study is underpinned by
- research question being asked
- research capability of the researchers
- availability of hardware and software to assist with the research process etc.

☺ The choice of whether to adopt the multimodal analysis method is therefore premised on the match between the research question, approach and method - See appendix 2 to help make the connections ☺

5) *Gather and record data*

Collect evidence / data with videos / voice recorders

☺ Before beginning data collection using videos and voice recorders, take the time to learn how to use these two pieces of equipment ☺

In our experience, the use of videos to collect evidence of student learning may lead to vast amounts of data to analyse. Therefore, it is important, from the outset of the project, to be clear about what and how much data needs to be collected.

☺ Identifying your main research question, as detailed in Section 3 and the units of analysis in Section 5, may assist with putting parameters on the data collection ☺

For instance, when studying a specific skill set, try to break down the skill into parts and only study parts of the skill. For example:

> *The study will use digital voice and video recorders to record* **interactions of apprentices with their tutors, peers and employers**. *The logistical issues pertaining to the use of technology to gather evidence of students' learning is adapted from Nuthall's (2001, 2007) work on classroom observations and recording.*

In the above excerpt, there is already a clear definition of what sorts of data to collect, i.e. to collect examples of interactions apprentices have with tutors, peers or employers in a workplace-based setting. Then the use of Nuthall's (2001, 2007) guidelines are used to provide direction on how much and how the data will be collected.

The mechanics of collecting data using videos and voice recorders will be dependent on research project context (Erickson, 2006; Nuthall, 2001).

☺ Note in many instances, it is advisable to use both videos and voice recorders as training environments can be very noisy ☺

This means the video will be able to record activities and interactions but may not be able to record actual conversations. Therefore, video recordings may need to be supplemented with the use of synchronised voice recordings. An example of how videos and voice recorders are used is provided in the following:

In finding out how apprentices learn welding, voice recorders were distributed to students. The voice recorders were activated and placed in the top breast pocket of students' overalls. Videos were taken of individual or groups of students working on their welding projects. Voice recordings were then synchronised with the video evidence. In most instances, voice recordings were also transcribed to provide for a more detailed study of the data. Another method used was to install voice recorders in welding booths to capture student interactions when they participated in peer learning sessions. Video recordings were not taken for this phase of the project as the size of the video booths and the welding activity made video recording of the process too difficult. Video footage would also not be useful as it would really only show the backs of apprentices as they worked on projects. Using a forward pointing video camera may have been useful but the size of the welding cabinet and the need to shield the camera from welding flare made this technically challenging.

When working with carpentry apprentices on construction sites. Videos were the main tool as the construction sites where most of the project was undertaken were relatively noise free. Only interactions between apprentices and trainers / supervisors were recorded. The video camera was focused on the interaction and was made quite close to the activity. This allowed for the conversation to be recorded verbatim on the video.

☺ Some recommendations for working with video / audio data include:

- *label / tag* all the data collected so that it is easier to sort and find data chronologically or systematically.
- *begin* each video or voice *recording* with an *opening statement* stating the time, place, students/apprentices involved and the reason (if possible) for why the recording is taking place.
- *archive* the digital files in a logical form, for example using activity and date as part of the file name and storing the files in distinct folders ☺

Why and how to use research journals

Research activities with an educational direction, are often conducted over a period of time by more than one researcher.

☺ It is therefore important to record ALL research activities ☺

This provides a sequential account of the research project and may be useful also as a tool for reflective or retrospective project evaluation.

In the authors' projects, research journals provided an audit trail, recording various data gathering and analysis sessions. A major advantage of maintaining a research journal is to record the learning of researchers, as the research process unfolds. This aspect is especially important for new researchers as it provides records that the new researcher may be able to draw on for sharing with more experienced researchers.

☺ Online research journals using blogging tools or web-based collaborative tools (e.g. Google Docs) may be useful for providing research teams with access to each other's journals / notes ☺

6) Analyse and interpret findings

In this section, the important task of data analysis is described. Here is an example of how to describe data analysis in a project.

The various forms of evidence will be organised using adapted forms of Nuthall's (2001, 2007), de Saint Georges and Filliettaz's (2008) and Holmes' (2006) data archival, retrieval and referencing guidelines. This forms a collection of data (corpus) from which various approaches of data analysis will be trialled to select a best fit multimodal analysis methodology for use in subsequent projects.

The data collected will be analysed using qualitative data analysis software (nVivo). If findings are difficult to distil using nVivo, then sports analysis software (Silicon Coach) and video annotation (Alasti) software will also be trialled and evaluated.

Once data has been gathered, the real and exciting work of data analysis begins. The role of data analysis is to find answers by employing a systematic scrutiny of the data. The process is one of induction, which is to allow the data ideas or solutions to arise from data. The term 'grounded theory' (Strauss & Corbin, 1990) is often used to describe the inductive/interpretive data analysis process but qualitative data analysis may take many other forms.

A broad explanation of qualitative analysis methods (Mutch, 2005) include:

- *Thematic* – the data is examined and patterns or themes of relevance to answering the research question are derived.
- *Semiotic* – is a deep form of study of the way in which the data is constructed grammatically and syntactically. Meaning is derived from how participants might use specific words or phrases to describe activities, processes or experiences.
- *Discourse* – the data is studied with respect to the socio-cultural contexts in which the data is collected. The aim is to derive meaning, statements, metaphors or even stories and images which are represented by the data.

- *Visual* – explores the data from a visual perspective, how text or voice symbolise perspectives of the research subjects or participants.

In this guide, the specific method of multimodal discourse analysis is introduced and described in the next section.

Multimodal discourse analysis protocols.

Multimodal discourse analysis, as the term itself implies, is to induct findings from multimodal data. Analysis of multimodal data, which is usually in the form of videos, pictures or voice recordings, is to use aspects of qualitative analysis as described in the above section. In particular, *thematic* and *discourse analysis,* as described above, are most useful.

In doing thematic analysis, the following process for comparative analysis (Mutch, 2005 adapting the work of LeCompte and Preissle, 1993) is recommended:

- *Perceiving* – this first step is to establish first impressions. Ask the question, what am I looking for? What is interesting about this section / piece of data?
- *Comparing* – While working through data, start to compare sections and pieces of data with each other. What is similar or different?
- *Contrasting* – Start to work out differences. How is this data different from what I have already coded?
- *Aggregating* – Organise the various sections or pieces of data into similar groups or categories. What are these categories? How should they be labelled or coded?
- *Ordering* – Start to form a hierarchy or flowchart of the various categories. Which categories or sub- categories are being formed?
- *Establishing linkages and relationships* – From the ordering exercise, start to form connections between the various categories. How do the categories relate to each other? Do they link with the literature?
- *Speculating* – Start to make sense of the themes which are emerging. Do they form a beginning to answering the research question? Do the themes fit? Do they need to be re-organised to provide a better approach at answering the research question?

The process, although not always linear, is to

- derive themes from the data,
- sort them into categories
- re-organise the categories into some form of meaning
- justify the categories through both the data trail and relevant literature.

For example, here are some themes from one of the projects undertaken to produce these guidelines.

In observing how students learn welding, themes derived include the solitary nature of learning welding in the welding workshop (which had welding booths as a safety requirement); the tactile nature of welding (students often 'felt' the weld to establish weld quality); the importance of recognising that correct welding generated certain sound characteristics; and the number of welding specific terms and concepts students had to learn.

Completing qualitative analysis with and without qualitative analysis software

The use of software tools to assist with the process of data analysis is discussed in this section.

Selection of the most appropriate method for data analysis is dependent on:

- Research question to be answered
- Depth of analysis to be undertaken with the data
- Type of data (e.g. interview transcripts or audio tapes or video evidence)
- Amount of data to be analysed
- Number of researchers involved in the project as some methods are more accessible to research teams.

Several methods useful in multimodal data analysis are described here:

- *Manual methods for text analysis* - themes in interview transcripts are highlighted using marker pens, interview transcripts are cut into strips and collated by clipping or stapling interview transcripts with similar themes together. Initial categories are then re-evaluated and re-sorted as required into relevant categories. This exercise can be achieved by an individual or a team of researchers.

- *Using a word processor* for text analysis - this allows for the above process to be automated using 'copy and paste' functions. Data which is sorted into themes may also be tabulated and this often simplifies the re-evaluation / re-sorting steps. The 'find' function may also be useful to find words which are associated to certain thematic categories. Generally, this method is achieved by one researcher and then other researchers will assist with the re-categorisation process.

- *Database software* for text and video analysis – various versions of software, useful for isolating, sorting, categorising / tagging text or video data may be used. Spreadsheet software (e.g. Excel) can be useful for simple comparisons and collation of demographical data. Database software (e.g. Access) can be used for text analysis whereby data can be shifted between folders and comparisons made.

- *Specialised software* for text and video analysis - qualitative data analysis software is useful for multimodal analysis due to the volume of primary data generated and the many streams of information which need to be analysed (i.e. video evidence presents both visual and audio data). It is therefore important to select appropriate software which will allow for the effective and efficient analysis of video data.

- *Sports analysis software* for video analysis - may be relevant for some research projects on trades-based learning. These software platforms allow for comparative studies of skills and movements to be undertaken.

Evaluation of several data analysis software was undertaken as part of preparing these guidelines. The results are very briefly provided here.

In undertaking the two projects used to construct these guidelines, two qualitative data analysis tools (nVivo and atlasti) and one sports analysis software (Silicon Coach) were evaluated. Each software package has advantages and disadvantages. In general, nVivo is well-suited to data analysis of text-based and short video data (e.g. interview transcripts); alasti was found to be useful for the analysis

of raw video footage. Silicon Coach will be useful if the research question seeks to complete a comparative study of learning involving kinaesthetic activities which requires body movement (e.g. carpentry apprentices learning how to use a handsaw).

☺ Each of the above forms of data analysis requires practice to learn, repetitive practice and eventual application and utilisation. In particular, you will need to learn new skills. ☺

These research skills include:

- *transcription* of data from the video or voice recorders into text. This requires practice as transcription of visual and voice data is time consuming and requires
  - watching and/or listening to data,
  - matching what is observed with what needs to be found (e.g as identified in research questions)
  - tagging and/or coding these observations
  - converting visual and audio data into text representations.

  ☺ When the authors began transcribing video data, each minute of video would take at least 10 to 15 minutes to transcribe, hence the importance of being organised and clear about the amount and type of data to collect ☺

  ☺ An example excerpt from a video transcript is provided in Appendix 7 ☺

- *conversion* of video or audio data into transferable formats. Raw data from video or audio sources might not be digitally stored in the format which all computers or the selected quality analysis software will be able to read. Therefore, download video and audio file conversion software and use this to convert video data into the required formats.

  ☺ There are several free video format conversion programmes which can be downloaded and installed on individual computers. Microsoft Media Manager also provides facilities for the conversion of several video and audio file formats. Become

familiar with some of the file formats for video including .mpeg, .MOD, .wmv and audio including .mp3, .wav, .wma and so on ☺

- T*he research question/s should guide* what to look for or listen out for when analysing data.

  ☺ The setup of an initial checklist which is aligned to the research questions is useful. However, ensure this checklist is updated as data analysis progresses. This is because the data may provide insights towards answering research questions and these new concepts may not have been initially identified ☺

- Learning how qualitative research software works will also take time. This includes learning how to navigate around the user interface of each piece of software in order to use the software for data analysis.

  ☺ Remember to factor in the learning time required ☺

Establish validity, reliability and perhaps generalisability

There is a need, when undertaking research to establish a degree of credibility in the projects findings. The main requirements are to provide evidence of:

- Validity
- Reliability
- Generalisability

The frameworks for meeting research quality are very much similar to ensuring assessments of learning are constructed to be valid, reliable and fair. Researchers need to understand how their project will meet quality measures and be prepared to defend their choice of research method during peer review processes. Each requirement is now briefly discussed.

- *Validity* - the prime method for establishing research validity is to ensure the research question is well constructed. Validity refers to how much a research method matches what has to be studied or measured (Wellington, 2000). As detailed in the above sections, a literature review has to be undertaken to focus the research topic and inform researchers of possible 'gaps' in the literature, research methods used in the past to investigate similar phenomenon and philosophies used to frame other projects.

From the information gathered through the literature review, the research question may be defined. Then, the research philosophy used to underpin the study can be located, connected and substantiated and the research method to be used is supported and confirmed. Findings from the study need also to be assessed for validity through how they match the original intend of the study.

- *Reliability* - research tools (e.g. questionnaires, surveys, interview questions etc.) should be checked to ensure that the data collected using each research tool, will be relevant towards answering the research question. Therefore, reliability implies how 'repeatable' a study is if it is re-investigated by a different group of researchers within similar contexts or situations (Wellington, 2000). Data analysis will need to be carefully documented and evaluated by several members of the research team or available for moderation if required. As described above, ethics requirements must be adhered to and the project will need to be approved by appropriate research ethics committees.

- Generalisability- whereby the findings of a study or project can be used to assist with helping or improving situations in other similar settings (Wellington, 2000). One of the main drawbacks of qualitative / interpretivist research approaches is the difficulty in generalising the findings of studies using these approaches. The number of research participants is often small and the specialist contexts will also make it challenging to generalise studies undertaken using qualitative / interpretivist research approaches. Therefore, in reporting the study / project, it is important to state the perimeters of the study (i.e. how many participants, the research method, context etc.) and to ensure readers are aware of the specific ways in which findings from a study have been derived.

  For example, the projects used in helping to build the guidelines provided here are placed at the very beginning. This sets the parameters from which this guide has been prepared.

Disclaimer: Note that although the guidelines have been generalised to carry out multimodal discourse analysis using video as the primary data collection tool, these guidelines have been compiled through work carried out in two specialised contexts. These are (i) study of the learning of welding by two groups of full-time students studying at a New Zealand

Polytechnic and (ii) project undertaken to study the interactions between apprentices and their trainers on building worksites.

7) State conclusions

Collate findings into a coherent report.

There are various ways to approach the writing up of a study.

☺ Here, we provide one way of approaching the task ☺

When most of the project is underway, it is important to begin compiling a report. A good way to begin writing a report is to start working with report headings. A suggested format is to include:

- *Title* page – describes the research in a short but attention grabbing sentence.
- *Contents* page – generate this last, after all the sections have been written using the 'styles' word processing function.
- *Abstract* – should be a very short summary of the project, its aim, research questions, method and key findings.
- *Introduction* – provide a context and perhaps the project's rationale.
- *Theoretical* framework or literature review – this needs to cover the pedagogical or theoretical foundation.
- *Research method* – clearly describe selection of the research method and briefly explain how research participants / subjects were chosen, data collection tools used, types of data collected and data analysis process.
- *Findings and results* – report the findings.

  With quantitative research, graphs, tables and statistical correlations are common ways to report results.

  In contrast, with qualitative research, it is appropriate to use

  - interview excerpts,
  - still clips from video,

- transcriptions of the audio components,
- narratives constructed from primary or secondary data sources.

to represent findings as these provide examples of the project's themes.

- *Discussion* – this is an important section, where project results / findings are connected with the theoretical framework. Key recommendations are also reported in this section.
- *Conclusion* – this brings the report to a close and sometimes offers recommendations for further research discovered through the research project.
- References / *bibliography* – details all the literature cited in report.

To begin, compile a concept or mindmap, either as hardcopy or digitally, of an overall argument for the report. Another method is to detail the contents in a table.

☺ Working on a shared overview is a helpful process when more than one person is working on the report so that all the report writers are able to work within a mutually derived framework ☺

Then, start by writing small amounts of text into each section of the report and gradually extend the report as each part of the project is completed. Once a rough draft of the report is completed, have a 'critical friend' read it to provide feedback on the report structure and content.

☺ After making any suggested changes, report writing, like all other forms of skill-based work, requires diligence and practice ☺

So work at the report to refine the clarity of language and have another 'critical friend' check the final draft before publishing. An example report is attached in Appendix 1. This draft report describes the project and findings from studying welding students' peer learning activities and is structured to be used as a foundation for future papers to be written for submission to conferences or journals.

8) Record references

The literature accessed and cited in the report should be collated into a bibliography.

☺ If readings are well archived from the start, either using index cards, a word processed table or through the use of a bibliographical database like Endnotes, the initial effort will be invaluable in keeping references organised ☺

The references are then useful for constructing

- the theoretical / literature review section of report,
- using the literature to support findings and
- linking existing literature to the 'case' or 'argument' constructed to support the answers to the research question. This is usually recorded in the discussion part of the report.

When citing literature and assembling the bibliography, remember to follow the conventions of a specific referencing style e.g. APA or Harvard. In using bibliographical database software like Endnotes, the bibliography / reference list will be automatically generated.

☺ However, the generated list will still need to be checked to ensure all the items have been transferred accurately ☺

In this report, the reference style used is based on conventions advocated by the American Psychology Association, also known as 'APA referencing'.

☺ Again learning how to cite references and write bibliographical details requires learning, practice and commitment ☺

9) Report research

For research to be useful, it has to be reported, shared / disseminated and most importantly, applied to improve teaching practice or to relate to approaches to enhance student learning. It is important to identify the fora for research dissemination or application. For instance, in which fields (education, vocational training, workplace learning, elearning etc.) will the findings be relevant? Then, work towards publishing and/or presenting findings / results to the chosen audience in the appropriate form, either as oral presentations or written reports, journal articles or book chapters.

Identify methods for appropriate dissemination of study

For example, here are the outputs proposed for the guidelines and the projects undertaken towards building the guidelines.

Papers and conference presentations at NZ Industry Training Forum, Australian Vocational Training Research Association (AVETRA), National Centre for Vocational Education Research (NCVER), Higher Education Research & Development Society of Australasia (HERDSA) etc. Possible book chapters related to vocational identity formation, multi-literacies, multimodal discourse analysis etc. Papers/reports generated from the project will be posted on Ako Aoteoroa website.

Identify methods for appropriate application of study

An especially fulfilling reward for putting in the time and energy into conducting research is the prospect of applying findings to assist with improving your own teaching or to improve learning outcomes for students. One proviso to always bear in mind is that research studies of the type described in this guide, have been undertaken at a specific time and place, underpinned by particular research approaches and often conducted with a small cohort of research participants. Therefore, it is important to acknowledge the findings from research studies as 'recommendations' rather than imperative decrees.

☺ Taking the above into account, it is important for findings from research to be applied to the improvement of practice in a constructive and critical manner ☺

Conclusion

The guidelines provided in this report, are to assist with the use of primary evidence gathering tools (i.e. videos and voice recordings) to collect real-world data of workshop or workplace-based learning activities.

☺ Remember, this is a *specific method* for carrying out research on student learning and there are many *other approaches* that are *also* suitable ☺

The purpose of this guide is to assist with building capability in a relatively new, time-consuming and skill intensive form of research activity. However, results obtained through using primary data gathering tools and multi-modal discourse analysis methods provide for a valid and reliable method for studying the complex processes which are involved in learning trade skills. Consequently, the time and effort expended in learning how to utilise multimodal approaches to studying actual activities when and where they occur, may lead to better understanding of students'/apprentices' learning processes.

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Appendices

Appendix 1

Sample report

(DRAFT - for CPIT / Ako Aotearoa circulation. This report will form the basis for development of papers to be submitted as conference or journal articles.)

Learning a trade: Improving the learning of welding using peer-learning and feedback

Abstract:

Due to safety considerations, much of students' practice and learning of welding, in a New Zealand polytechnic, is conducted within individual welding booths. This presents some challenges to student learning as collaborative peer learning within a workshop learning environment is affected. The project reported in this paper, established peer-learning as an opportunity to enhance student learning. Techniques of feedback were presented to students to circumvent reported disadvantages of peer learning. This short paper provides results of introducing peer-learning, supported with relevant feedback techniques, to improve learning outcomes for welding students.

Keywords: skills-based learning, peer-learning, feedback, multimodal discourse analysis

Introduction

At Christchurch Polytechnic Institute of Technology (CPIT), students practise and learn welding skills in specialised workshops. The learning of welding is involves students observing detailed practical demonstrations by skilled welding tutors, followed by students' practice of welding skills. Practical skills learning were supported by classroom learning of theory knowledge specific to understanding the technology of welding. One aspect of the welding workshops' configuration at CPIT is the utilisation of individual welding booths within which students practise and learn welding skills. These booths are constructed to contain individual students' welding activities within safe parameters. This is due to welding practice safety requirements which generates bright light arcs, sparks and heat. Welders involved in welding activity, wear protective clothing (overalls, leather aprons, leather gloves, welding helmet) to protect themselves from heat and sparks. However, utilising individual

welding booths means students' learning becomes dependent on individualised learning. Unlike learning activities conducted in other trade areas at CPIT, e.g. light fabrication, joinery, cookery etc., students are unable to share their immediate learning experiences with other students as welding activities progress within enclosed spaces. Therefore, this project was conceived to investigate the advantages of allowing students to work in pairs, whilst learning welding, in particular, to find out if peer-learning opportunities for students would lead to enhanced acquisition of welding skills.

Firstly, this brief report discusses the socio-cultural teaching and learning approaches underpinning this project. Secondly, theoretical frameworks for using videos and voice recorders to collect primary evidence of students learning welding and peer learning as a teaching and learning method are explained. Additionally, background is provided on recommendations for enhancing peer feedback between students. Thirdly, the methods used to collect data on peer learning activities and the multimodal discourse analysis process is described. Findings, using a transcript from part of a peer learning session, explain the processes of feedback utilised by students to assist learning. Finally, a discussion on the methods used to complete this project and implications from findings are developed.

Socio-cultural theories of learning

The precepts of Vygotsky and socio-cultural approaches to teaching and learning (Packer & Goicoechea, 2000) underpin the conduct of this research study and impinge on the subsequent findings detailed in this report. Vygotsky's contribution shifts thinking from perspectives of learning as being only individually derived; towards learning as being socially and culturally influenced and developed through participation in activities (Billett, 1998; Sfard, 1998). As such, learning manual skills encompasses more than just motor skills learning (Evans, 1994; Summers, 2004) and learning practical knowledge (Jarvis, 1994) but also involves a form of 'enculturation' into specific trade skills' community of practice (Wenger, 1998) and practices which define communities of practitioners (Gherardi, 2010). Hence, learning a skill may be understood as 'learning as becoming' (Hodkinson, Biesta & James, 2008; Chan, 2010). In the case of students learning welding, as learning to become welders.

Of note to this project, is Vygotsky's premise of the 'zone of proximal development (zpd)' to describe the difference between what learners are able to accomplish without

assistance, compared with what they are able to do with help from others. Assistance may be provided by peers, parents/relatives, teachers or co-workers (Wertsch, 1984). Much of the work studying the efficacy of zpd and its application to peer learning is in early childhood and primary school learning (Tudge, 1992; O'Donnell & O'Kelly, 1994; Hogan & Tudge, 1999). In the field of workplace-based learning, guided participation (Rogoff, 1995; Billett, 2002) espouses adoption of forms of peer learning to assist workplace learning. Therefore, in this project, the introduction of peer learning to assist welding students to expedite learning is reported.

Theorectical framework for this project

Using videos

A better understanding of how apprentices learn skills in on (Rex, Steadman and Graciano, 2006) and off-job environments is required. In the book *The Hidden Lives of Learners* (Nuthall, 2007), the minutiae of students' interaction with peers, teachers and school environment during classroom teaching and learning activities was studied using technology available in the 1980s and 1990s. Recent work on communications in workplace settings (Holmes, 2006) and apprentice learning in formalised institutional environments (de Saint-Georges & Filliettaz, 2008) has provided more up-to- date techniques for garnering and analysing data. The advent of digital technology has also been accompanied by the need to study human interactions using socio-cultural research approaches (Sfard, 1998). Although now widely used to improve sports performance (Summers, 2004), there is little evidence in the literature of the use of videos to enhance trades /craft learning. Therefore, inclusion of video and voice recorders in educational research requires a considered rationale (Erickson, 2006) and a studied and planned approach (Erickson, 2006; Nuttall, 2001).

Aspects of peer learning

For the purposes of this project, the definition adopted to describe the process of peer learning is as 'the use of teaching and learning strategies in which students learn with and from each other without immediate intervention from the teacher' (Boud, Cohen & Sampson, 1999 p.413). Advantages of peer learning include the development of skills related to collaboration and teamwork; increased responsibility for the learner to engage in reflection and exploration of new possibilities; encouragement for students to articulate their understanding; and improved 'learning to learn' strategies (Boud, Cohen & Sampson, 1999).

Unlike pure zpd approaches that require a more experienced peer tutor, the peer learning utilised in this project, relies on two or more learners, forming collaborative learning groups. One of the challenges of using this form of learning is that peers may be unable to provide adequate assistance due to their unfamiliarity with the task or process (Tudge, 1992; O'Donnell & O'Kelly, 1994) Hence a more structured approach to introduce novices / learners / students to peer learning is necessary. The next section describes one method which may support the peer learning process.

Importance of feedback in learning

Hattie's (2009) meta-analysis of over 800 quantitative studies on teaching and learning, found student feedback, usually from a teacher, to be an important factor contributing to student learning. However, for feedback to be effective, it has to be deployed in a structured and meaningful manner. Hattie and Timperley (2007) advocate the use of three forms of feedback. These are:

- Feed up – are the learning objectives being met?
- Feed back – what is the performance level on learning?
- Feed forward – what does the learner need to do to improve learning or move to the next objective?

These three forms of feedback need to be used carefully to provide learners with information on task, process, self-regulation and self (image). Hattie and Timperley (2007) also recommend judicious use of feed back on 'self' as terms like 'well done' or 'good work' or 'could do better' do not provide any indication of what was done well or needs to be improved. Therefore, it is important for students, who will be undertaking peer learning activities, to be well-prepared for providing appropriate and relevant feed back.

Research method

Students participating in this project were completing a six month full-time course in welding. Some of the students would have had some prior exposure to welding through completion of other courses at school or polytechnic or through work related training. Permission was sought from the CPIT welding section to allow students to work in pairs within welding booths. Students were briefed on the required safety precautions for working together in booths. In practice, only one student welds while another observes, and students take turns to

work on either similar or individual welding projects. The interactions of pairs of welding students were videoed and/or voice recorded. These recordings were transcribed and analysed using atlasti qualitative analysis software package. Transcriptions were studied as to the richness of interactions and the ways in which feedback was relayed between students.

There were 16 students in the course. The project began four weeks into an 18 week course. Students were paired through tutors' evaluation of initial welding ability, as evidenced by assessed work in the preceding six weeks. Students were provided with short workshops, interspersed through the data collection stage, on objectives of the peer learning process and appropriate / effective use of feedback during peer learning sessions.

Videos and voice recorders were used to collect primary evidence of student learning activities. Primary evidence does not require research participants to articulate activities in hindsight. Instead, the actual activity is recorded and data is available for detailed analysis. Primary evidence collection is most useful in this study, as many of the students are novices, learning an unfamiliar skill. As such, secondary evidence collection may not reveal important nuances of skill acquisition which students are unaware exist. Video and voice recordings were transcribed and analysed through processes of multimodal discourse analysis, which seeks to understanding not only the actual activity recorded but also underlying inferences conveyed (Erickson, 2006; Harper, 2005), for instance by non-vocal communication (Burgoon, 1994).

Findings

One transcript of student interaction taken 4 weeks into the 18 week course is used to illustrate the use of feedback by two students, learning the dip transfer welding process. Dip transfer is a method whereby the wire dips in and out of the weld pool, creating a short circuit and melts. When compared to spray transfer which produces a larger weld pool, dip transfer melts the wire and fires off small particles across the weld pool. In the exchange provided in Table 1 and detailed in the left hand column, two students, Bill and Steve (not their real names and marked in the table using different fonts), analyse how to improve dip transfer task performance. In the middle column, each sentence in the interchange is analysed as a form of feedback. The interconnections deduced as part of data analysis are detailed in the right hand column. Both students were assessed by tutors as being similar in ability and progression through the welding programme.

Table 1

Analysis of Feedback

Conversation	**Feedback**	**Comments**
Bill - That's a decent amount of spattering then, hey.	Feed up	Here Bill checks with Steve to find out if the weld is progressing correctly.
Steve- Yeah. That's it.	Feed back	Agreement means both are able to judge the weld is progressing as required.
I am watching, I am watching the um, the weld pool burn in, as I am tidying it along and I am going quite slow.	Feed up	Bill explains the welding action to Steve.
Do you get much of an angle on that, the travel angle?	Feed back	Steve checks to find out if there is another aspect to doing this kind of weld as body position is an important part of achieving good welding.
It's going like that	Feed up	Agreement on travel angle suggests both understand the role of travel angle in completing dip transfer.
Oh yeah.	Feed back	Bill and Steve concur.
I am putting it to the side a bit but also I am getting my torch a lot closer than you.	Feed back	Again, Bill is able to verbalise the comparison between his and Steve's welding effort.
Yeah.	Feed back	Agreement indicates both appreciate the difference that getting the torch closer might make.
So I think, with the dip transfer, that's the key, it's getting the torch a lot closer.	Feed forward	Bill communicates an understanding of the effect of torch distance to eventual weld quality.
You can see it as well, hey, like.	Feed up / Feed back	Steve's agreement and both have learnt to observe torch distance when completing this form of welding.
Yeah it's got a different sound to it too.	Feed up / Feed forward	Bill synthesises concepts of welding sound and correct technique to accomplish sound weld.

Discussion

In the example provided in the above section, Bill and Steve moved through a feedback cycle which firstly acknowledged the activity was undertaken (feed up). As the activity progressed, feed back was used to confirm or discuss important aspects of the welding process. As the welding task was completed, the conversation shifted to feed forward aspects. Bill and Steve discussed ways in which welding practice might be improved by adopting certain techniques (adjusting travel angle, moving the torch closer, attending to the welding sound), evidencing improvement in welding process knowledge.

Another important aspect from the above excerpt in Table 1 is the ease with which Bill and Steve used welding terms (dip transfer, weld pool, burn in, travel angle). Over the first month of the course, students have learnt how to use these terms in the appropriate

context through repeated use of these terms by the tutor and then students as the course progressed. The excerpt above provides good examples of aspects of situated learning (de Saint-Georges & Filliettaz, 2008) and the adoption of inter-subjective understanding (Tudge, 1992; Hutchins & Klausen, 1998) specific to welding activities. Aspects of scaffolding (Shepard, 2005), another precept founded on Vygotsky's work, are recognised in the feedback cycle as the two students discuss the concepts they already seem to understand about the relationship between the welding task and the welding machine settings. From the initial concepts articulated at the start of the exchange, the move towards feed forward, encourages both students to build on their understanding towards improving the next iteration of the task. In particular, both students begin to form shared understandings of how welding tasks may be accomplished. Through forming inter-subjective understanding or a shared vocabulary and perspective learnt through engagement with welding practice, both Bill and Steve are beginning to learn the social norms and cultural practices (Gherardi, 2010) of welding and becoming welders (Hodkinson, Biesta & James, 2008; Chan, 2010).

Analysis of video recordings of a similar exchange indicate how deeply engrossed both students are in the task of examining how each student approaches welding tasks and then evaluating the process just undertaken. The precursor activity of the conversation provided in Table 1 would be Steve completing a welding task while observed by Bill. In the excerpt above, Bill refers to his observation of Steve's travel angle and welding torch placement. Therefore, the affordances provided by peer learning have allowed both Bill and Steve to learn from each other, aspects of welding which are important towards accomplishing welding competency.

Conclusion

As reported by Nuthall (2007) and also by Tudge (1992), collaborative learning activities undertaken by students, may lead to unintended learning outcomes. Hence, peer learning activities should be initially teacher guided and structured. One method for providing guidance is to assist students with the process of providing feedback to peers. In this project, students were provided with a suggested framework for providing peer feedback. An examination of peer learning interactions indicate many peer groups to be using effective peer feedback strategies, in turn, leading to an acceleration in students' welding skill acquisition. Further investigation will need to be undertaken in order to explore the actual

effectiveness of peer learning within vocational settings, in particular, to find out what actual aspects enhance peer learning and under what conditions peer learning may be most effective.

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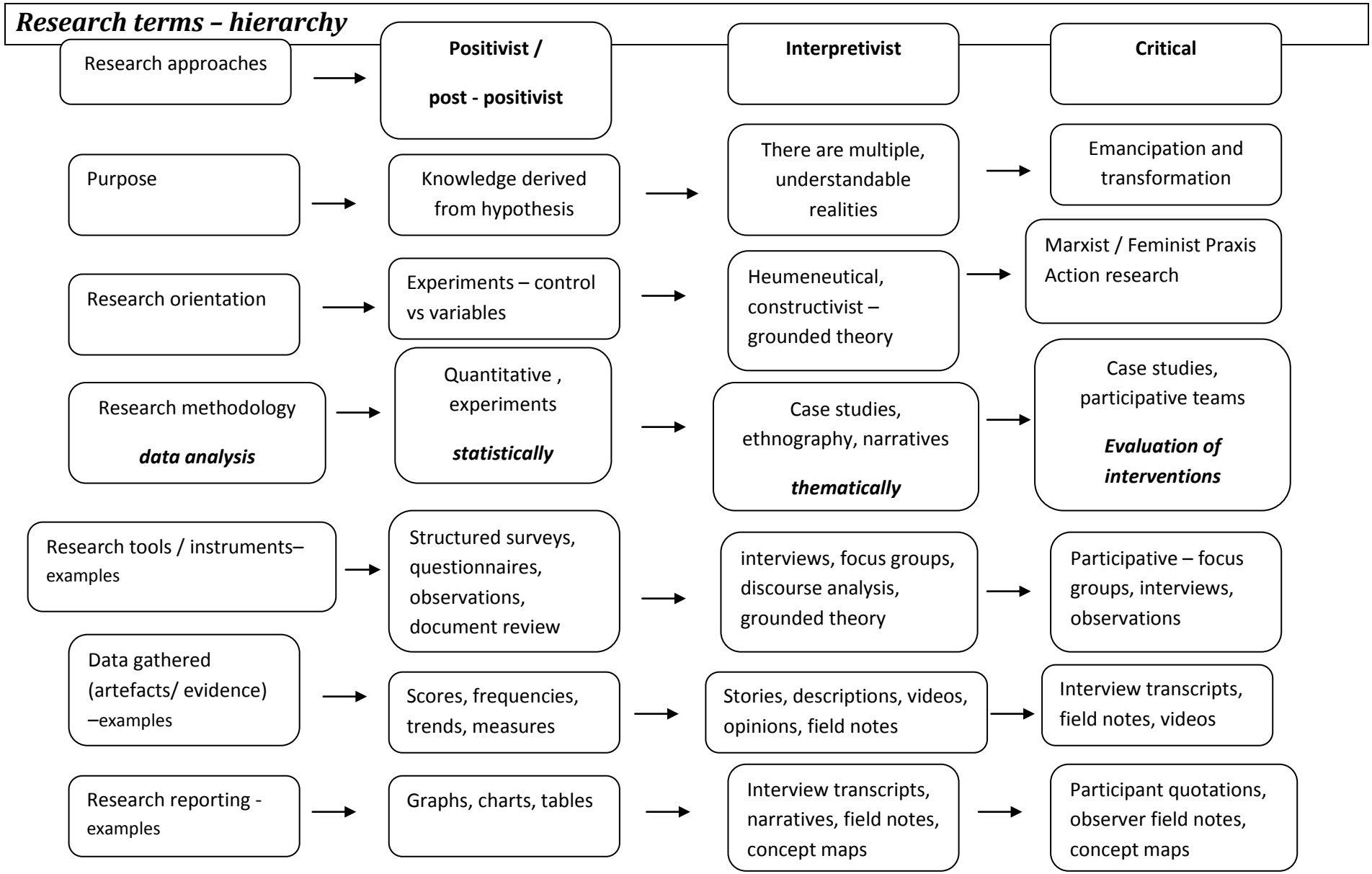
Appendix 2


Research terms – hierarchy
Research approaches
Positivist / post - positivist
Interpretivist
Critical
Purpose
Knowledge derived from hypothesis
There are multiple, understandable realities
Emancipation and transformation
Research orientation
Experiments – control vs variables
Heumeneutical, constructivist – grounded theory
Marxist / Feminist Praxis Action research
Research methodology
data analysis
Quantitative , experiments
statistically
Case studies, ethnography, narratives
thematically
Case studies, participative teams
Evaluation of interventions
Research tools / instruments– examples
Structured surveys, questionnaires, observations, document review
interviews, focus groups, discourse analysis, grounded theory
Participative – focus groups, interviews, observations
Data gathered (artefacts/ evidence) –examples
Scores, frequencies, trends, measures
Stories, descriptions, videos, opinions, field notes
Interview transcripts, field notes, videos
Research reporting - examples
Graphs, charts, tables
Interview transcripts, narratives, field notes, concept maps
Participant quotations, observer field notes, concept maps

Appendix 3

Template for literature review summary

With examples

Themes	**article**	**Summary / contribution**	**Copy archive**
-Skill learning -Transfer of learning	Berner, B, (2009). Learning control: Sense-making, CNC machines and changes in vocational training for industrial work. *Vocation and Learning, 2(3)*, 177-194.	*Uses a comparison of learning how to use CNC machines from the 1980's and 2006, using situated learning principles, to understand how students make sense of CNC programming.*	S drive – project folder – references Hard copy – skill acquisition
-Learning theories	Collins, A., Brown, J., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator*, 15(3), 38-47.	*Provides rationale for 'making thinking visible'. Model derived from studies of apprenticeship and used to assist school students to learn reading, writing and arithmetic. Stages in cognitive apprenticeship presented and described.*	S drive – thesis folder – learning theories Hard copy – cognitive apprenticeship

Appendix 4

Annotated bibliography of useful readings and references

The authors have found the following to be useful resources for researchers undertaking multimodal research projects to study student learning.

☺ Annotations are provided to assist with selection of readings or references ☺

Berner, B, (2009). Learning control: Sense-making, CNC machines and changes in vocational training for industrial work. *Vocation and Learning*, *2(3)*, 177-194.

Not many research articles focus on trades-based learning. This article uses a comparison of learning how to use CNC machines from the 1980's and in 2006, using situated learning principles, to understand how students make sense of CNC programming.

Collins, A., Brown, J., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator*, 15(3), 38-47.

Seminal article on cognitive apprenticeships which argues the case for using principles of teaching and learning derived from studies of apprenticeship, to assist with the teaching of reading, writing and mathematics. A must-read for all trades tutors ☺

Burgoon, J. K. (1994). Non-verbal Signals. In M.L. Knapp and G.R. Miller (Eds.). *Handbook on interpersonal communication* (pp229-285). Thousand Oaks, CA: Sage Publications.

The first part of this chapter (pages 229 – 232), introduces the types of non-verbal signals undertaken by people when they interact with each other. Examples provided (pages 233 -234) and overview of non-verbal communications in interpersonal contexts (pages 236 – 239).

Burke, A., & Hammett, R. F. (2009). Introduction: Rethinking assessment from the perspective of new literacies. In A. Burke & R. F. Hammett (Eds.) Assessing new literacies: Perspectives from the classroom. New York, NY: Peter Lang.

A good introduction to the concept of 'new literacies' which advocate a move away from the text-based literacies predominant in education to recognise important 'other' literacies required by contemporary society.

Cope, B., & Kalantzis, M. (2000). *Multiliteracies: Literacy learning and the design of social futures*. London; New York: Routledge.

Another relevant reading on the importance of recognising multiliteracies, mainly from the viewpoint of literacies founded on individuals' social and cultural backgrounds.

Cummings, J. J., & Maxwell, G. S. (1999). Contextualising authentic assessment. *Assessment in Education: Principles, Policies and Practices*, *6*(2), 177-194.

Defines the term 'authentic assessment' and relates definition to various learning and teaching theories. Provides good background for arguing the merits of authentic assessments including application to competency-based assessments.

de Saint-Georges, I., & Filliettaz, L. (2008). Situated trajectories of learning in vocational training interactions. *European Journal of Psychology of Education*, *23*(2), 213-233.

An example of a project, undertaken to study students engaged in workshop-based learning of metal work, using multimodal data collection, analysis tools and methodology.

Evans, G. (1994). Learning in apprenticeship courses. In J. Stevenson (Ed.). *Cognition at work: The development of vocational expertise* (pp 76-102). Leabrook, South Australia: National Centre for Vocational Education Research.

A good introduction to carrying out research in a vocational education workshop setting. The study is of manual metal arc welding and how an 'expert model' is derived to improve competency-based learning and assessments.

Eraut, M. (2004). Transfer of knowledge between education and workplace settings. In H. Rainbird, A. Fuller & A. Munro (Eds.) *Workplace learning in context* (pp. 201-221). London, England; New York, NY. Routledge.

Transfer of knowledge between what is learnt during training courses and what needs to be applied in a workplace situation is discussed in this article. An important piece of work which provides foundations for thinking about 'knowledge transfer'.

Filliettaz, L. (2010). Guidance as an interactional accomplishment: Practice-based learning within the Swiss VET system. S. Billett (Ed.) Learning through practice: Models, traditions, orientations and approaches. London: Springer.

Another example of the use of multimodal discourse analysis to understand interactions between apprentices/learners and trainers/teachers.

Gobo, G. (2008). *Doing ethnography*. Los Angeles, USA: Sage.

A highly readable introduction to qualitative research and ethnographical research. A good book for the beginner researcher on the ways in which qualitative researchers approach and think about their work.

Hager, P. (2004). The conceptualisation and measurement of learning at work. In H. Rainbird, A. Fuller & A. Munro (Eds.) *Workplace learning in context* (pp. 242-258). London, England; New York, NY. Routledge.

This article provides a good reference source for workplace-based research studies.

Harper, D. (2005).What's new visually? In N. K. Denzin & Y. S. Lincoln (Eds.) *The SAGE handbook of qualitative research* (3rd Ed. pp. 747-762). Thousand Oaks, CA: Sage Publications.

There are not many articles available on analysing visual images. This article provides background and some concepts.

Hodkinson, P. (2004). Research as a form of work: Expertise, community, and methodological objectivity. *British Educational Research Journal*, *30*(1), 9-26.

An overview of the challenges presented to educational researchers. A philosophical argument for educational researchers to maintain their credibility in the face of increasing pressures to produce findings that have to conform to government directives.

Hodkinson, P., & Hodkinson, H. (2004). The complexities of workplace learning: Problems and dangers in trying to measure attainment. In H. Rainbird, A. Fuller & A. Munro (Eds.) *Workplace learning in context* (pp. 259-275). London, England; New York, NY. Routledge.

Here, the Hodkinsons, describe the challenges of researching workplace learning. A good reference source for arguing aspects of validity and reliability associated with undertaking qualitative research projects.

Holden, R., & Smith, E. (2009). Practitioner researchers in vocational education and training. *International Journal of Training Research, 7*(2), 134-144.

This article discusses advantages and challenges pertinent to teachers/tutors teaching and researching in the vocational education and training sector.

Jarvis, P. (1994). Learning practical knowledge. *Journal of Further and Higher Education, 18*(1), 31-43.

This is an important article, providing a definition of practical knowledge and proposes techniques useful for studying how learners attain practical knowledge.

Kalantzis, M., Cope, B. & Harvey, A. (2003). Assessing multiliteracies and the new basics. *Assessment in Education, 10*(1), 15-26.

This article proposes the means by which multiliteracies may be assessed.

Kemmis, S., & McTaggart, R. (2005).Participatory action research: Communicative action and the public sphere. In N. K. Denzin & Y. S. Lincoln (Eds) *The SAGE handbook of qualitative research* (3rd Ed. pp. 559-603) Thousand Oaks, CA: Sage Publications.

An short introduction to principles and approaches of action research.

Mutch, C. (2005). Doing educational research: A practitioner's guide to getting started. Wellington, New Zealand: New Zealand Council for Educational Research.

A highly recommended introductory text for beginning educational researchers. Well-structured and written in a readable and accessible style.

New London Group (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, *66*(1), 60-92.

The seminal article, introducing the reasons for the recognition of multiliteracies and proposes strategies for applying the concepts towards improving education.

Nuthall, G. (2001). Project on learning: Classroom recoding and data analysis. Christchurch, New Zealand: University of Canterbury.

Nuthall's description of the method used to study classroom learning.

Nuthall, G. (2001). Procedures for identifying the information content of student classroom experiences and predicting student learning. Christchurch, New Zealand: University of Canterbury.

A more in-depth description of the methods Nuthall and his team of researchers use to study classroom learning using videos and voice recorders.

Nuthall, G. (2007). The hidden lives of learners. Wellington, New Zealand: NZCER Press.

This book records findings from projects, carried out through the 1980s and 1990s in New Zealand primary schools, to try to understand learning from primary school children's perspectives.

Schmidt, R. A., & Wrisberg, C. A. (2008). Motor learning and performance: A situation-based learning approach (4th Ed.). Champaign, IL: Human Kinetics.

A sports performance-based book that provides good foundation on the research undertaken in understanding how humans learn motor skills.

Silverman, D. (2006). *Interpreting qualitative data: Methods for analysing talk, text and interaction* (3rd Ed.) London, Thousand Oaks, New Delhi: Sage Publications.

A more advanced reading of the processes of qualitative data analysis. This book provides many examples and important guidelines relevant to how qualitative researchers construct meaning from data.

Stevenson, J. (2004). *Cognition at work: The development of vocational expertise*. Leabrook, South Australia: National Centre for Vocational Education Research.

A collection of interesting and pertinent articles on learning at work and concepts of vocational understanding and expertise.

Summers, J. J. (2004). A historical perspective of skill acquisition. In A. M. Williams & N. J. Hodges (Eds.). Skill acquisition in sport: Research, theory and practice (pp. 1-26). London, England; New York, NY: Routledge.

Skill acquisition from a sports skill perspective which provides foundational understanding of how humans acquire motor skills.

Appendix 5

Sample information letter

Project title:- **Learning a trade: Developing guidelines to study trades learning in the workplace using multimodal discourse analysis methods.** (students)

Researchers' contact details:

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Flip Leijten

Tutor

Trades Innovation Institute

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What is this research about

In this project, the ways in which students learn a trade will be studied using a method which involves recording and analysing students' learning activities. We will use video cameras, voice recorders and mobile phones to collect examples of learning activities in both workshop and classroom settings. As part of this project, some of the activities in your class will be recorded.

You may also be invited to provide copies from your course workbook or photos of the project you are working on to help us better understand how you are learning. The results of this project will be used to further develop research on teaching and learning.

What will take place

- You will be provided with a short tutorial to introduce you to the process.
- During selected workshop and classroom sessions, video and audio taping of whole class and individual students participating in learning activities will be undertaken.
- Your participation in this project will be entirely voluntary.
- You may ask for the video taping or audio recording to be stopped during the course of each session.

How your interests will be protected

- Your name or your face will not be used in any of the reports on the findings from this research.
- You can decline to take part in the project.
- The recordings will be stored in a password protected computer accessible only to the researchers.
- Recordings will only be transcribed and viewable by the researchers.
-

Your decision on whether to take part in this trial will not affect your treatment or your course results at xxx.

As the researchers, we will not be involved as a tutor or assessor during your course at xxx.

You are welcome to contact us to ask questions about this research project before you agree to take part. Your contribution to this research project will be useful in developing a better understanding of how trades student learn.

Thank you ☺

Appendix 6

Sample consent form

Consent form for research project

Learning a trade: Developing guidelines to study trades learning in the workplace using multimodal discourse analysis methods.

I have read the information letter and have had the details of the research project explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I realise that whether or not I decide to take part in this project is my decision.

My decision to participate or not participate in this research project will not affect my course results at xxx.

I agree to take part in the trial on the understanding that my name or face will not be used in any of the reports on the findings from this research.

The recordings and information I have supplied will be used only for this research and the publications that arise from this research project.

The recordings and information will be stored securely for five years, after which they will be destroyed.

I agree to participate in the above study under the conditions set out in the information letter.

Participant :

Signed: **Name:** **Date:**

Researcher:-

Signed: **Name:** **Date:**

Researchers' contact details:

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Appendix 7

Example of video transcription

Excerpt (10 minutes) from a video and voice recorder transcription of a nick-break exercise

	verbal			Activity		Non-verbal - student	
Time video	**Time - audio**		**coding**	Nick break sample		**hands**	**body**
4.31 - start	2.14	Student (H) H - bloody hell!		Just completed nick break		Touches nick break	Examining sample
	2.24	H- Yeah -				Holds sample	Looks about - uncertain
	2.32	Tutor (F) F- do you see anything you want to tell me about, on your nick break? I will carry on recording right now. Anything you want to show?		H. carries sample to show tutor.		Turns sample around	Close examination of sample
4.49	2.42	H- Ah, I really, ar maybe. I reckon it's a fail		tutor evaluation.		Turns sample around	" "
	2.49	F- You reckon its failed?		Tutor and student interchange		Fingers rub cut edge	Looks intently at sample
	2.50	H- Yeah.					Peers in
	2.52	F- Would you explain, in your view, why it has failed?					Still looking at sample
5.15	2.58	H- Um, I reckon it's got some slag or something caught in there.				Puts finger into sample to point at source of slag.	Looks at tutor then back at sample
	3.00	F- OK					
	3.02	F- Do you mind bringing it up to the camera here? So that the camera can have a look at it. Put it up a bit, that's it				Turns sample	Lifts sample to 'show' camera. Looks at camera.
	3.10	F- So In your view you have, what, contaminants in it?					Nods - twice
5.31	3.13	H - Yeah. In there				Points to contamination / defect	