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Scope of Information Technology Research in the Domain of Instructional Technology

1   Executive Summary

A review of the range and nature of New Zealand research related to the topic of instructional technology was undertaken as an assessment item for the 06.804: Research Methods course. This course forms part of the UNITEC Master of Computing programme. The review classified forty two examples of published articles in the domain by the type of research employed. Sub-groupings within each type of the nature of the research was then undertaken.

The analysis showed that there is a predominance of research using normative methods with 63% of the research following a normative paradigm, 32% following an interpretive paradigm, and 5% following a mixed paradigm.

Qualitative research methodology was used most frequently in the research papers investigated (44%). A quantitative methodology was adopted by 39% of the research papers, with significantly smaller numbers using an experimental or mixed methodologies (5% and 12% respectively).

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3   Introduction

Research in the domain of instruction technology takes many forms, with published articles demonstrating a range of methodologies, techniques and research paradigms. Traditionally this research has been to some extent restricted to the objective scientific methods expected in the sciences. Use of qualitative analysis, with a more subjective and naturalistic direction, has provided publications with a more ideographic approach to research.

This report describes the range of research encountered by the writers of the report, restricting the literature search to that published either by New Zealanders or in New Zealand publications. It categorizes the research by identification of research type, then discusses the various sub-groupings that were identified within each type.

4   Terms of Reference

This report has been prepared as the first assignment for the 06.804: Research Methods course. This course forms a part of the UNITEC Institute of Technology Master of Computing programme. The report has been prepared by the four authors, as an element of assessment specifically intended for group work.

The parameters and requirements are described in the assignment provided by the lecturer, with the group to determine methods of work and collation of materials for the final report.

The report is to concentrate primarily on electronic databases available to identify the range and nature of research related to the topic of instructional technology. The emphasis is to be on "New Zealand research" - research carried out by New Zealanders, carried out in New Zealand or published in New Zealand journals and books.

The report is to classify a minimum of forty examples of published articles in the domain by the type of research employed. The report is then to identify

sub-groupings within each type of the nature of the research that was undertaken.

A minimum of forty references published since 1996, including at least twenty from publications that have had peer review, are to be provided in an annotated bibliography.

5   Procedure

The authors identified a range of potential sources for appropriate research articles.   Each author surveyed and identified a number of suitable articles, providing information required for the annotated references. The bibliography concentrated on the nature and method of the particular research involved, in contrast to the specific findings of the research which might normally be included in an annotated bibliography.

The structure of the report was drafted to provide headings and subject areas for further development.

Individual work on specific sub-topics provided content, with the syndicate working for the most part to a "horizontal approach" to the planning process of a report (Eunson, 1994).

6   Discussion

Research is any systematic activity designed to develop or contribute to knowledge. The two most commonly used research paradigms are the qualitative and quantitative paradigms. While qualitative research uses words to build a holistic description of a social or human problem according to the views of informants, quantitative research tests a theory by measuring and statistically analysing numbers in order to determine if the predictive generalizations of the theory concerning the social or human problem are true (Creswell, 1994).

6.1 Qualitative Research

Qualitative research provides a framework for researchers that is in stark contrast to the objective and generally numerical approach of the scientific method in research. Burns (2000) describes it:

> "Qualitative research places stress on the validity of multiple meaning structures and holistic analysis, as opposed to the criteria of reliability and statistical compartmentalisation of quantitative research." (p. 11).

The qualitative approach can be described in more detail by examining some of the predominant methods used for data collection and analysis.

6.1.1   Ethnographic Research

Ethnography means writing about people. Burns (2000) describes ethnography to:

> "… encompass[es] any study of a group of people for the purpose of describing their socio-cultural activities and patterns." (p. 393).

It generally involves studying a society, or some part of a society, in depth. The purpose of ethnographic research in education is to obtain a "picture" of what is actually happening within a particular group or in a particular situation.

The primary method of data collection is often observation with the researcher frequently becoming a member of the society or culture being studied, while other methods such as interviewing and qualitative analysis are also used.

6.1.2   Interviews

Both qualitative and quantitative data collection can use interviews, in a variety of ways. The major advantage of an interview over a survey is the opportunity for the researcher to probe the subject further, based on the response to questions. This can create possible problems as well – as Bell

(1999) points out, interviewing can become very subjective, injecting any bias the interviewer may have.

Interviews can range in style along a continuum of formality. A very standardised (structured) interview is the easiest to quantify and analyse, if this is the intention of the research. At the other end of the continuum, an unstructured interview can provide useful extra information, as the interviewer 'fishes' for it. As described in Bell (1999):

> "Unstructured interviews centred round a topic may, and in skilled hands do, produce a wealth of valuable data, but such interviews require a great deal of expertise to control and a great deal of time to analyse." (p. 138).

Another informal alternative to an interview is a personal diary. Subjects can be directed to compile a diary of behaviours, feelings, actions, opinions during the course of the research. This process will probably also be very time-consuming to analyse, and the responses from various subjects could be quite difficult to match and compare. The diary can be coupled with one or more interviews to clarify points.

6.1.3   Action-Research

Elliot (1991), cited in Altrichter, Posch & Somekh (1993), gives a simple definition of action research as:

> "…the study of a social situation with a view to improving the quality of action within it". (p. 4).

The action research style of qualitative research is used extensively in educational research as it can be used to assist teachers with the many challenges they are faced with when curricula and methods of delivery change and assist them to reflect on these changes. Action research is conducted by people who are directly involved with the situation that is being researched. Altrichter, et. al. (1993). Action research frequently uses critical methods as the researcher is aiming to develop or improve the

current situation by collaborative action, as described by Zuber-Skerritt (1991).

Cohen & Manion (1994) describe how educational action research can fall into five categories:

1. A specific situation containing problems and the action research can remedy or improve the situation

2. A means of providing professional development to teachers by increasing their analytical skills and self-awareness

3. A way of providing teachers with the reason for including innovative approaches in their teaching

4. A way of improving communication between the teacher and the academic researcher

5. Providing a structured method of problem solving in the classroom.

Action research can be a cyclical process. The research can lead to improvements in the way that a process is done which can then be investigated and reflected on.

Zuber-Skerritt (1991) describes the four elements of action research as:

1. **Plan** – analyse the problem and decide the strategy for investigating the problem.

2. **Act** – implement the strategic plan.

3. **Observe** – evaluate the implementation of the action.

4. **Reflect** – decide if the evaluation will lead to improvements or if further research and investigation is required.

6.1.4   Case Studies

Case study research allows for one part of a problem to be investigated thoroughly over a limited period of time.

Bell (1999) describes the greatest strength of the case study method as:

"that it allows the researcher to concentrate on a specific instance or situation and to identify , or attempt to identify, the various interactive processes at work". (p. 11).

A case study researcher in education will typically investigate the characteristics of an individual unit e.g. one student, one class, one school. The purpose of the investigation is to analyse relationships between all present variables so that generalisations can be made about the wider population to which the unit belongs. Cohen & Manion (1994).

While Cohen & Manion (1994) refer to observation as being the primary method of data collection, Anderson (1990) describes other methods of data collection: documentation and file data, interviews, site visits incorporating direct observation and examining physical artefacts such as students' assignments.

6.1.5   Historical Research

Cohen & Manion (1994) explain the value of historical research as:

"the ability to employ the past to predict the future, and to use the present to explain the past" (p.45).

Historical research involves evaluating and synthesizing evidence gained from documents, records and personal experiences and recollections of others. The researcher is often working with incomplete or inadequate data with the result often being a broad view of conditions and not necessarily the specifics that brought about these conditions.

Historical research has value in the fields of education and instructional technology because it allows education researchers to learn from what has been done in the past in order to evaluate the ways in which newer and emerging methods of delivery and assessment are used.

Historical research is often of a qualitative nature as the researcher is interpreting natural behaviour in a real situation. Limitations of historical research are the inability to validate the conclusion, that conclusions are drawn from incomplete data and unless data is drawn from more than one source, there is a possibility that the data is biased. (Anderson, 1990).

6.1.6   Developmental Research

Development research is a problem oriented and interdisciplinary research methodology which can be undertaken as case study, experiments, action research or evaluations studies. Development research is performed in order to optimize and gain a sound basis for development activities. Richey (1996) identifies two purposes through which development research can be characterized

- development of prototypical products, and

- generating methodological directions for design and evaluation of such products (Zulkardi, 1998).

6.1.7   Case and Field Studies

It is sometimes appropriate to use both qualitative and quantitative case and field study research methods in tandem (McWilliam, 1991). Kerlinger (1986) described case and field study research as:

> "… nonexperimental scientific inquiries aimed at discovering the relations and interactions among sociological, psychological, and educational variables in real social structures" (p. 372).

These social structures represent social "units," or cases, and can be comprised of an individual, group, institution, or community (Isaac & Michael, 1981). A distinctive characteristic of case and field studies is intensity. Many experimental and quasi-experimental methodologies require large sample sizes to examine even a limited number of variables. Conversely, case and field studies examine only one social unit (case), often while examining a large number of variables or even a total unit, element, or event (Isaac & Michael, 1981). Case and field study research can be employed to test hypotheses, but often are used instead for exploration of significant variables or the relationships between variables. (Nassar-McMillan, 199?)

6.1.8   Analytic Induction

Analytic induction is a method of data analysis described by Znaniecki (1934) who named the method and systematized many of the associated ideas.

However Znaniecki was careful to note that the essence of analytic induction has been used repeatedly throughout history, particularly by scientists in the physical sciences (he cites numerous examples from physics and biology). That essence involves " . . . inducing laws from a deep analysis of experimentally isolated instances" (p. 237).

Analytic induction can be contrasted with defining and using terms in advance of research. Instead, definitions of terms are considered hypotheses that are to be tested. Inductive, rather than deductive, reasoning is involved, allowing for modification of concepts and relationships between concepts occurs throughout the process of doing research, with the goal of most accurately representing the reality of the situation. (Ratcliff, 19??).

6.1.9   Code-based Methods
Code-based methods involve the study and analysis of codes which can range from computer code to social cultural rules such as code-of-conduct. Rightley, Henninger & Hanson (1998) suggest two methods in differentiating computer code itself in order to determine the sensitivities that are of interest, thereby avoiding the difficulties that equation-based methods can have:

- manually, by examining the code and producing appropriately programmed derivatives, or

- automatically, using a tool that will look at each line of code and produce derivative values automatically.

6.1.10   Grounded Theory
Grounded theory uses an inductive approach utilizing a systematic set of procedures to arrive at a theory about basic social processes. The aim of this approach is to discover underlying social forces that shape human behavior, by means of interviews with open-ended questions and through skilled observations.

An exhaustive literature review is not done so as to allow theory to emerge directly from the data and remain "grounded in" the data. Literature is

reviewed continuously throughout data collection and analysis. When describing the findings, descriptive language must be used to provide the reader with the steps in the process and the logic of the method. Data are compared continuously with other data (constant comparison method) to detect emerging categories and themes and to direct the data collection process. (Hodgin, 19??).

6.1.11   Discursive Approaches

The "discursive practice" specialization deals with the processes by which cultural meanings are produced and understood. The key objective of a discursive practice approach is to develop theories and techniques relevant to the analysis of meaningful behaviour in actual situations. The discursive practice approach is grounded in four insights concerning discourse. One is the affirmation that social realities are linguistically/discursively constructed. The second is the appreciation of the context-bound nature of discourse. The third is the idea of discourse as social action. The fourth is the understanding that meaning is negotiated in interaction, rather than being present once-and-for-all in our utterances. (Anonymous 1, 19??)

6.1.12   Content Analysis

Content analysis examines words or phrases within a wide range of texts, including books, book chapters, essays, interviews, and speeches as well as informal conversation and headlines. By examining the presence or repetition of certain words and phrases in these texts, a researcher is able to make inferences about the philosophical assumptions of a writer, a written piece, the audience for which the piece is written, and even the culture and time in which the text is embedded. Due to its wide array of applications, content analysis is used by researchers in literature and rhetoric, marketing, psychology and cognitive science, as well as many other fields. (Anonymous 2, 1997-2000)

6.2 Quantitative Research

Some of the categorisations of quantitative research were presented in Burns (2000).

There is danger in attempting to ascribe causality even when dealing with data collection that can be perceived as 'quantitative'. That is, even with numerical support for a hypothesis, it is sometimes unwise to attempt to claim that the result was directly attributable to the factor being examined in the experiment.

While the assignment of causality in the world of science might be seen to have some degree of rigour, in the field of behavioural studies it can often lead to error. As described by Bell (1999):

> "…the experimental style does allow conclusions to be drawn
> about cause and effect, if the experimental design is sound, but
> in education and the social sciences generally, large groups are
> needed if the many variations and ambiguities involved in
> human behaviour are to be controlled." (pp. 9-10).

6.2.1 Experimental Design

Quantitative or experimental research can take a number of forms. Central to the type of data collection and analysis is the issue of a *control* group within the experiment. Creswell (1994) identifies four types of experimental design:

- **Single-subject**, in which a single individual (or group) is observed over time

- **Pre-experimental**, in which there is no control group for comparison with the experimental group

- **Quasi-experimental**, in which there is a control for comparison and validation purposes, but the subjects are not assigned to each group at random

- **Pure experiment**, where the subjects of the control and experimentation groups are assigned at random.

6.2.2 Distribution and Significance

When conducting any form of research that involves dependent variables or a correlations study (which will have more than one variable), the frequency

of distribution can provide some initial indications of spread and centring. The researcher creates a series of categories to sort the data obtained by the experimental processes, and determines the number of data values that fall into each.

The analysis of centre, spread and the shape of the distribution provides important information about the data obtained. In performing numerical analyses, such mathematical constructs as "mode", "mean" and "median" (each with a specific meaning) might well provide some initial indication of the centre or "middle" of the data.

The concepts related to distribution allow the researcher to quantify and characterise the aspects of spread (how far from the middle point the data extends) and shape (how close or far the data is from an accepted "normal distribution").

Spread provides a measure of variability within the data obtained. Shape allows the researcher to make certain other assumptions relating to the data. A skewed distribution curve, with a long extension into one direction from the centre and a quick "dropping off" in the other direction, or a normal distribution of the data (in the form of the symmetrical normal distribution curve), may well allow for the researcher to make some initial assumptions and even conclusions regarding the data that was obtained.

Significance is a calculated measure of value that can be obtained from an analysis of the data. Significance describes the probability of obtaining similar or greater results indicating differences between the two groups (the samples) in a repeat of the experiment. That is, significance attempts to determine whether any differences identified are, in fact, due to the aspect being examined, or could the difference simply be due to sampling error.

6.2.3   Sampling Methods

A means of obtaining a truly random sample in experimental method underlies the entire concept of sampling. In a random sample, every example from the population will have an equivalent chance of being part of

the sample obtained. The inclusion or non-inclusion of any individual data item should be by chance alone.

The use of random sampling can be seen as an initial means of eliminating inherent bias. That is, the population from which sampling is to occur must (to a greater or lesser degree) be established as representative of the population to which the researcher expects to extend the conclusions.

To obtain a random sample that is large enough to demonstrate mathematically that it is, in fact, truly random and representative may well exceed the size and budget of many experimental methods. Because of this, other sampling methods may be preferred.

- **Stratified sampling** involves the use of segments of the population to be examined, with a random sample drawn from each segment. This guarantees at least some degree of representation from each of the segments, and overall might provide assurance of coverage of the population.

- **Proportionate sampling** extends that concept by limiting representation within the segments to that proportion the segment represents of the entire population. This would ensure that a small segment would not have been over-represented in the sample used in the experiment.

- **Systematic sampling** describes the selection of samples that can be applied to the other methods listed above. That is, after obtaining a large list of potential items/individuals to include in an experiment, systematic sampling describes the use of, say, only every fourth item in the list. Because the initial list is considerably larger than necessary, it provides a wider sampling of the population as a whole.

The methods of obtaining a random sample as described are only a minimal description of the techniques available. Often, the size or nature of a population to be sampled may provide particular problems requiring other sampling systems. Sophisticated, and often complex, selection methods for the sample are described in the literature, allowing a potential researcher to

obtain a sample by means that can be defended mathematically, as described by Bordens & Abbot (1999).

6.2.4 Surveys

Creswell (1994) describes:

> "… A survey design provides a quantitative or numeric description of some fraction of the population – the sample – through the data collection process of asking questions of people." (p. 168).

This comment clearly identifies the *survey* as a quantitative rather than a qualitative research method. Creswell uses the survey as an instrument of the positivist methodology, in which the researcher seeks to measure 'reality' by some instrument (the survey in the instance), with a view to establishing 'cause and effect'.

Creswell suggests clear analysis tools for specific surveys designs, i.e. single or multi-stage (clustering). The multi-stage survey uses an initial survey to identify individuals within groups (clusters), and then surveys further within each cluster.

6.2.5 Power and Effect

Power is the term used to describe the ability of a statistical test to determine whether the results obtained by an experimental method to, in fact, indicate "real difference". In order to proceed to this conclusion, however, the researcher must in fact reject the opposite possibility – that there are no real differences between the two samples that could not be described by chance expectation. The rejection of the "null hypothesis", the testing to conclude (as described in Burns, 2000):

> "… that there is no statistically significant population correlation or difference". (p. 111).

is a necessary precursor to the acceptance of an alternative hypothesis, the one actually being put forward by the researcher.

Power for a researcher is the measure of how well the experimental method can reject the claim that the results could not be repeated, that they were obtained only by chance in the selection of the sample or experimental method used. "A powerful statistic is more sensitive to differences in your data than a less powerful one (Bordens & Abbot, 1999, p. 375).

Effect size is a term that describes how much the manipulation of a particular variable (the independent variable) in a researcher's experiment might change the dependent variable. Effect size is very difficult to estimate prior to the completion of a study. The relative size of the effect can only be determined with any degree of accuracy once the data collection is concluded and analysed. Effect is "… the *degree* to which the phenomenon is present in the population" (Burns, 2000, p. 167). The use of the effect size can allow conclusions about a particular variable across a series of experiments, without regard to sample sizes, variances obtained and the means of the data in the different experiments. Perhaps more importantly, it can be readily used to assist in the calculations relating to sample size in a study to provide a particular level of power.

6.2.6   Hypotheses of Difference

6.2.6.1   Independent Groups (Between-Subjects Design)
A *Between Subjects* experimental design involves subjects who belong to one experimental group, and therefore undergo one experimental procedure, only. This provides for a simple 'cause and effect' analysis, where changes in behaviour/result are more likely to be attributable to the one variable change

6.2.6.2   Paired Groups Design (Within-Subjects Design)
A *Within Subjects* experiment involves subjects being part of more than one treatment group. This creates a much more complex set of possible relationships between cause and effect, and also leads to questions of *order effects* (as in Cresswell, 1994), wherein the order in which subjects underwent the experimental procedures may influence the overall outcomes.

6.2.7   Hypotheses of Relationship

6.2.7.1   Ex Post Facto Research

Ex post facto research refers to studies where an existing condition is observed and an attempt is made to find possible factors that have occurred in the past that have caused the condition to occur, as described in Cohen & Manion (1994).

There are two types of *ex post facto* research. A co-relational or causal study involves collecting two sets of data, one of which has occurred in the past and attempting to determine the relationship between them. A causal-comparative or criterion group study is similar to experimental research as it tries to discover causes for why an event happens by comparing the subjects when a variable is present with similar subjects when the variable is absent, as described in Cohen & Manion (1994).

6.2.7.2   Chi-Square

The chi-square test is one example of a non-parametric test that can be used to determine the relationship between two variables. While parametric tests may be preferable overall, due to the measure of power generally inherent, often the data collected may not meet the assumptions required for parametric statistical analysis.

The chi-square test can determine whether two variables are related or independent. Assume that a survey collected information about both gender and attitudes to information technology in the classroom. By applying a chi-square test to the data obtained, the researcher could determine whether the differences in response to the second question are directly related to the first. That is, could a person's gender, for instance, be useful in predicting their potential attitudes to the technology employed? If the chi-square calculations indicates significance, the researcher has determined that the two variables are significantly related in some way. A limitation, however, is the necessity for the variables to each have only two categories. Though the use of the chi-square test can be extended by conducting separate tests on sub-sets of the responses, the test has most value in determining

relationship in the simple two variable, two responses each variable situation.

6.2.7.3   Rank Order Correlation

Correlation between two variables exists when each particular value of one variable can be paired with the value of the second variable. For example, correlation is "positive" if the number of hours that a student has spent studying for an assessment can be matched against their assessment grade, as described in Lowry (2000).

The Spearman Rank Correlation Coefficient uses ordinal numbers, and the ranks of the scores, not the scores themselves. For example this test could be used to determine the relationship between the variables of students' IQs and their leadership qualities when those variables are both measured by ranking scales, as described by Runyon, Haber, Pittenger, & Coleman (1996).

The result of the correlation coefficient test is that if there is a perfect positive correlation, the coefficient equals 1, if there is a perfect negative correlation, the coefficient equals -1 and when the correlation isn't perfect the coefficient lies between -1 and 1.

6.2.7.4   Product-moment Correlation

The Pearson product moment correlation coefficient is used when the variables are related in a linear fashion. It is calculated by multiplying the z scores of the two variables by one another and then calculating the mean of these products. For example, in order to determine if there is correlation between students final examination marks in one course and their overall course grade, the Pearson test could be used, as described by Runyon, et. al. (1996).

6.2.8   <u>Prediction and Linear Regression</u>

It is sometimes necessary in research to predict what could happen based on previously gathered data. Linear regression analyses the relationship between two variables, X and Y. For each subject (or experimental unit), X and Y are known and analysis is used to determine the best straight line through the data. In some situations, the slope and/or intercept have a

scientific meaning. In other cases, you use the linear regression line as a standard curve to estimate new values of X from Y, or Y from X. For example, the number of times that students contribute to a discussion board is plotted against their assessment mark. The linear regression line could be used to predict the number of contributions required to achieve a particular mark, as discussed in Runyon, et. al. (1996).

6.2.9   Analysis of Variance (ANOVA)

ANOVA is a technique used for analysing data when there are more than two groups of data to be compared. It provides the method to compare many different things and situations at once. ANOVA compares the means of all groups in a single test. The statistical definition of the analysis of variance (ANOVA) is described by Runyon, et. al. (1996):

> "A method, described initially by R.A. Fisher, partitioning the sum of squares from experimental data into known components of variation." (p. 484).

6.2.10   Reliability

Reliability describes the consistency of a measurement. If a measurement technique is completely reliable it produces the same results each time the technique is used. If the data collected from research is not reliable and valid then it is meaningless, as described by Runyon, et. al. (1996).

6.2.11   Replication

The ability to repeat an experiment, to obtain equivalent results in subsequent experiments, is one of the fundamental principles of quantitative research. The nature of some quantitative research, particularly that carried out in the field of education (involving students, teachers and the learning process), can make this somewhat problematic. Nevertheless, most researchers acknowledge the desirability, while admitting to the difficulties, as described by Gunstone & Leder (1992):

> "What I am suggesting is that there are two important aspects
> of replication in educational research. First replication of studies
> is a necessary activity. Secondly, whether or not a genuine
> replication is taking place, whether or not contexts (including

people) are sufficiently similar to consider a second experiment
to be a replication of a first experiment, are questions with no
absolute answer and are the subject of important debate. Value
judgments must be made and this is one reason why replications
are uncommon in this field of research." (p. 34).

6.3 Combination Method and Design

Combining quantitative and qualitative research approaches to a study
provides the researcher with the opportunity to draw on a much wider range
of design and approach.

The word 'triangulation' is sometimes used to describe the combination of
qualitative and quantitative methods. The word can also refer to the use of
a variety of means to collect and evaluate qualitative data, as described by
Patton (1990), and to provide a means of verification and validation in the
steps of qualitative analysis. Both meanings draw on the concept of
verification of a finding by multiple means, offering an increased confidence
in the results obtained.

Cresswell (1994) provides a framework for describing combination methods
and designs, describing:

- The **two-phase design** approach, with the researcher conducting two
  separate phases of the study using the two methods.

- The **dominant-less dominant design**, with one small component of
  the research drawn from the alternative paradigm, and

- The **mixed-methodology design**, with a "mix (of) aspects of the
  qualitative and quantitative paradigm at all or many methodological
  steps in the design" (p. 178).

7   Analysis of Content

An analysis of the methods and methodologies used within the papers
considered here will shed some light on those favoured by researchers in
recent years. Cohen & Manion (1994) refer to the two conflicting views of

research in education. On the one hand, the social sciences are essentially the same as the natural sciences, and should therefore conform to natural and universal laws – hence scientific (quantitative, normative) research methods. The opposing view maintains that social sciences, while sharing the rigour of the natural sciences, emphasises that people differ from inanimate objects and from each other – hence a more interpretivist approach to research. In our study area of Instructional technology, a mix of the two paradigms is likely, given the (sometimes uneasy) crossover of the disciplines.

Of those research papers where the research paradigm was evident, analysis shows as follows:

Normative	26 (63%)
Interpretive	13 (32%)
Mixed	2 (5%)

There is clearly a predominance of research using normative methods. This is even more true of research in the primary and secondary sectors, though based on small numbers (in only 1 of 6 papers – Falloon (1999) used an interpretive approach). At the tertiary level (80% of the papers reviewed), the ratio of the normative paradigm to the interpretive was 13:9. While obviously these results are inconclusive due to a relatively small sample, it is clear that at all levels, there is seen to be more value in normative research. It is also possible that the paradigm reflects the researcher as much as the research, or that normative research is simply 'easier to do', though a much bigger sample would be necessary to confirm this.

When analysing the research methodology used in the reviewed papers, the following results are found:

Experimental	2 (5%)
Mixed	5 (12%)
Qualitative	18 (44%)
Quantitative	16 (39%)

Several papers used a classical experimental approach (Lavery, Townsend & Wilton, 1998 and Vargo, 1998), while five others used a mixed methodology (Crump & Godley, 2000; Fleming & Findlay, 2000; Malcolm, 2000; McFarlane, 1997 and Outred, 1997). In the other papers, the spread between qualitative and quantitative was reasonably even - the difference in a sample this small is not significant. It could be argued that there is a significant difference within the educational level, given the following values:

	Secondary	Tertiary
Qualitative	1	14
Quantitative	3	11

From these figures, research conducted in a secondary school is more likely to be quantitative, while that carried out in a tertiary institution is more likely to be qualitative. This tendency towards qualitative research at the tertiary level is perhaps supported by the slightly higher percentage of papers in that sector (i.e., 30% against 26% for the whole sample) using the interpretive paradigm as mentioned above. Again, the review of a larger number of papers would be needed to draw more definitive conclusions.

Data collection methods also reveal a variety of approaches. As could be determined from the papers, the following methods were used:

Surveys	13 (20%)
Interviews	9 (13%)
Observation	10 (16%)
Questionnaires	6 (9%)
Case studies	9 (14%)
Action Research	7 (10%)
Tests	5 (7%)
Others	7 (10%)

Many papers used a variety of data collection methods, and an initial analysis reveals little correlation between paradigm, methodology and

collection method. A conclusion could be that analysis tools exist (e.g., NUDIST) for qualitative data as much as quantitative, so that data can readily cross methodologies in its final use. It is evident that a mixture of interviews, surveys, case studies and observation are seen as useful in a large amount of the recent research done in Instructional technology.

Although questionnaires and surveys may be the most popular means of data collection in sociological research, they not always the most in-depth. While these have become a favoured style of empirical investigation, other less obtrusive methods such as observation, written records (e.g., journals and diaries) and material culture can have more validity, as the researcher's activities do not disturb the behaviour being analysed.

Data analysis method figures of:

Percentage	12 (33%)
Count	8 (23%)
Means	3 (9%)
Triangulation	2 (6%)
p-test/t-test	2 (6%)
Others	8 (23%) (including ANOVA, NUDIST, no analysis, and observation)

indicate a majority of quantifiable analysis methods inline with quantitative research are being used. The results show a lack of specific named software data analysis tools (one mention of NUDIST) which could indicate that researchers are content to stay with spreadsheeting tools. Various reasons why may have to do with in-house funding politics or perhaps extensive time and learning curve requirements.

8   Conclusions

Cohen and Manion (1994) categorise the two research methodologies as *normative* and *interpretive*. These match closely to our understanding of the quantitative and qualitative paradigms. The description of *normative* is summarised by two major ideas: " … first, that human behaviour is essentially rule-governed; and second, that it should be investigated by the methods of natural science." In contrast, the *interpretive* model of research design is characterised by a concern for the individual.

An alternative comparison between these two paradigms lies in the perceived cause or intent of behaviour. The normative research will look for behaviour as a response to external or internal stimuli, i.e. the cause of the behaviour lies in a response to the past. By comparison, the interpretivist will focus on behaviour as an action which leads to some further outcome. It is 'behaviour with meaning', and as such, is oriented to some future purpose.

A further distinction is provided by Zuber-Skerritt (1991). A positivist research method is where the researcher is objective. In the research report the people being researched are referred to in the third person. He explains the interpretivist research method as where the researcher is aiming to understand people's actions.

The choice of research methodology must precede the research design process. The interpretive researcher will be more likely to use qualitative methods, though this is not necessarily an exclusive relationship. Creswell outlines the key differences in developing a qualitative or quantitative research project.

In a qualitative project, the language is more likely to be in the 1st or 2nd person (i.e., refers to the researcher as 'I', or 'you') whereas a quantitative project will probably be written in the 3rd person ('he' or 'she'). The language of a quantitative introduction will be more formal, referring to a literature review, and developing a pre-determined design. In a qualitative project, the introduction will be less reliant on prior literature, developing a design as the project progresses, and referring to the literature as theories

and interpretations emerge. Theories, such as social and ethnographic theories may become integral to qualitative research, but these will usually develop during the study, rather than being a precursor to the study itself.

The grounded theory approach (Creswell, 1994) uses the process whereby data is collected first, then the theory is generated as the data is being analysed. Both the research design and the questions and theory at its base will evolve as the data is collected and analysed. Once the theory is sufficiently well developed (grounded), prior literature is then reviewed and related to it.

A quantitative research work will use a hypothesis which is developed from the supporting theory – it will use deterministic terms such as 'affect, influence, impact, cause, relate', and other such descriptions. It will involve independent and dependent variables which can be measured separately. A qualitative research work will relate to general questions rather than a hypothesis. The questions will probably be non-deterministic (such as discover, explain, explore, and similar queries) – they will probably evolve during the course of the project rather than being a limiting factor in the inquiry.

Data collection and analysis techniques will also differ in qualitative, quantitative and experimental research. A qualitative study is more likely to use data collection methods such as interviews (unstructured, open-ended,as in Foley 1998), observations and personal journals (kept by either researcher or subjects). A quantitative project will use sampling techniques such as surveys, structured interviews, measurement - e.g., Lavery (1998) and Ross (2000) and true experiments using control and experimental groups, e.g., Vargo (1998).

Analysis methods in a qualitative study may well develop during the data collection process. Analysis and reporting may be narrative in style, relying on a process of data reduction and interpretation. Analysis systems of matrices and coding can often be useful in quantifying narrative data – e.g., NUDIST (Herrington, 1997). In a qualitative analysis there will more often be issues of verification and reliability which need to be considered or

addressed. A quantitative study will use more statistical data analysis tools – comparing sets of values for dependent and independent variables. Statistical tests such as *t-test, ANOVA, covariance*, and the like are generally used to look for levels of significance of similarity or difference - e.g., Halliday (2000), Hunt (2000), Lavery (1998), Parr (1997) and Ross (2000).

Quantitative data will usually place more importance on its ability to be replicated and verified – that the data and the conclusions drawn from it are reliable.

A mixed methodology is sometimes seen as an appropriate design. This may be a considered decision in the initial project design, or may develop as a means to develop or support some aspect of the research. Creswell (1994) cites from Greene (1989), a list of five possible reasons and purposes for a combination of both qualitative and quantitative methods:

- **Triangulation** - seeking a convergence of results from various aspects of a study, as in Foley (1998) and Vargo (1998)

- **Complimentary** – looking for overlapping and different facets which may emerge from the research

- **Developmental** – where the first method helps to inform and develop the second method

- **Initiation** – as contradictions and fresh perspectives emerge

- **Expansion** – adding scope and breadth to the study

It is interesting to note that in the papers reviewed for this assignment, the two that claimed to have used triangulation as an analysis technique, were both judged to be in the *normative* paradigm, one using quantitative and the other using experimental methods. This appears to be at odds with the purpose of triangulating between mixed methodologies.

In the evidence of the 38 papers in the field of instructional technology considered here, it appears that a range of methods and methodologies could be appropriate. There is no clear preference for one paradigm over another, and the combination of design, data collection, literature review and analysis follow no distinctly discernible pattern. The choice remains open to

the researcher, though research methods theory suggests that there are clear guidelines to follow. For the specific combination of research topic, researcher and subjects, a valid and defendable research method will be found.

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10 Annotated Bibliography of Research Related to Instructional Technology

Burbules, N.C. (1997). Privacy, surveillance, and classroom communication on the internet. ACCESS – Critical Perspectives on Cultural and Policy Studies in Education, 16(1), 42-50.

A critical review of the concepts of 'invasion' and 'privacy' as they apply to the educational experience. The author concludes, primarily upon the basis of an examination of the literature, that privacy should be viewed as an outcome, rather than as a 'protected sphere' (that some invasions of privacy can be seen as 'good' for the person and therefore acceptable). The conclusion is that privacy principles should not be traded off for good intent. The work is qualitative, relying heavily on the further development and synthesis of ideas published about the concepts.

Crump, B., & Godley, C. (2000). Computer-aided learning of project planning within a constructivist framework. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

The researchers at Massey University sought student opinions on the use of collaborative software and how it affected their learning. A questionnaire collected qualitative and quantitative data. Students were able to express their opinions on the ways in which the software contributed to their learning and also completed likert scale questions and yes/no questions. The analysis of the quantitative data was limited to counts and percentages. An interpretive paradigm was used to allow the researchers to understand students' views. The students viewed the software positively and felt that it had improved their understanding of the concepts of project planning.

Dewstow, R., McSporran, M., & Young, S. (2000). Remote remedies: Challenges when teaching on-line. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

Qualitative and quantitative questionnaires and interviews were used by lecturers at UNITEC to identify issues that arose when a course was offered during the summer semester in a totally on-

line mode. The results of the questionnaires were compared with similar questionnaires conducted in previous semesters. Analysis of responses was confined to means and counts. As the course was run in a condensed format during a summer period students experienced difficulties with group projects and submitting assignments electronically. Students also missed the lack of personal contact between lecturers and students although a discussion board for discussion and problem solving had been provided.

Falloon, G. (1999). Developing exemplary practice: Why are some teachers better at IT than others? *Computers in New Zealand Schools*, 11(3), 19-23.

Observations of classroom teaching and interviews with six teachers of year 7 and 8 students in the Far North draws conclusions of the teacher and classroom style which lead to best use of IT resources. Falloon suggests that teachers more likely to make productive use of computers in a classroom were those using a more constructivist approach to their lessons. He concludes that these teachers are more likely to be 'risk-takers' in their classroom management, allowing students more leeway in their work methods. By comparison, the instructivist, 'transmissive' teacher is less likely to see ways (or allow students to see ways) in which computer technology can be applied.

This was a qualitative study, based on surveys, observations and interviews, using an interpretivist framework. No specific analysis is provided to give statistical support to the conclusions, though recommendations are made for pre- and in-service teacher training.

Ferguson, B. (2000). Helping us teach – Who do we select for our degree programme. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

The researcher at Waikato Polytecnic used *ex post facto* research with quantitative methods to compare student pass rates with prior academic achievement. Other factors such as age and gender were also taken into consideration. The researcher gathered information from enrollment data and course results. He concluded that, in general, as long as students had met the entry requirement their entry qualifications bore no relationship to their subsequent performance. Female and mature students with an acceptable entry qualification showed a higher chance of success

in later study, however mature students who were admitted to the programme without having at least passed mathematics in the 6th form had difficulty with the course of study.

Fleming, H., & Findlay, T. (2000). Internet access: The challenges and opportunities in the learning environment. *The New Zealand Journal of Applied Computing and Information Technology*, 4(1), 3–7.

Researchers at Wanganui Polytechnic used a case-study approach with mixed-methodological design to study the effect on the learning environment of students being provided with on-campus 24 hour a day access to the Internet. Students, tutors and information technology support staff were surveyed and interviewed. The quantitative data was reported in percentages of frequency of response. The researchers concluded that students were spending too much time on the Internet and felt that this was detrimental to their studies and recommended that student access to the Internet be restricted. They also recommended that students be provided with greater training on the use of the Internet and alternative methods of research. *(NB team: mixed-methodological design defined on p 183 Creswell)*

Foley, G., & Schuck, S. (1998). Web-based conferencing: Pedagogical asset or constraint? *Australian Journal of Educational Technology*, 14(2), 122-140.

This study looks at the responses of a number of pre-service teachers to the use of the conferencing tool (discussion board) using Top Class. Students engaged in a series of discussions about mathematics education, and data was gathered about their impressions in a variety of ways – pre- and post-intervention surveys, reflective journals, and open-ended questions. The open-ended questions (which were part of the post-intervention survey) were used as a means of triangulating between the responses in the first two phases of data gathering. The surveys used a five-point Likert scale to position students' opinions of such things as understanding of computer conferencing, confidence in their use of computers, the appeal of conferencing as a communications medium, and other categories.

This is a quantitative research project, using surveys and interviews to gather and then analyse opinions. The change in attitudes was tested using a two tail t-test, looking for significance at the 5% level.

Halliday, J. (2000). ICT in secondary schools: Fact or fiction? *Computers in New Zealand Schools*, 12(2), 7-12.

This study (as part of research for a Masters thesis) surveys secondary schools on the attitudes of teachers to the use of ICT, the activities it was being used for and the support structures for teachers within their schools. Responses are broken down by curriculum area, and a link is made to the degree of support for integrating IT into the curriculum, as perceived by both teachers and HODs. This is largely a quantitative study, with responses mainly in terms of percentage use, mean hours per week and other such statistical analysis. Little analysis is shown to discuss comparative rates of use, perceptions or degree of integration. The report on attitudes to school support and access to professional development is largely anecdotal.

Herrington, A., & Oliver, R. (1997). Multimedia, magic and the way students respond to a situated learning environment. *Australian Journal of Educational Technology*, 13(2), 127-143.

This study investigates the response of eight tertiary students (pre-service teachers) to a multimedia learning environment. The students were immersed in a multimedia simulation or preparing and presenting a series of lesson plans. They were videotaped over two weeks of use, then interviewed at the end of this time. None of the students had significant previous experience with computers , and their reactions to the interface and the learning environment was sought.

Data was analysed using NUDIST, a qualitative analysis tool, enabling text data to be reduced and displayed, and conclusion to be drawn and verified. There was no mention of how the video record was linked to the interview analysis, but it allowed a number of assumptions to be drawn about the interface and its stability and user-friendliness.

Housego, S., & Freeman, M. (2000). Case studies: Integrating the use of web based learning systems into student learning. *Australian Journal of Educational Technology*, 16(3), 258-282.

This study presents five case studies of tertiary teachers using web based delivery systems to augment their courses. The cases cover a range of institutions, curriculum areas and prior exposure of the teachers to web based systems. A range of experiences, both positive and negative are reported, along with discussion of

the some of the remedial strategies following the negative issues. Institutional issues are also highlighted as contributing to teacher satisfaction with these systems; issues such as central support of systems, teacher workload, departmental culture and intellectual property are considered.

The research methodology used for this study is an 'educational case study', cited as being an appropriate method for "exploration of significant facts, … creation of plausible interpretations … and construction of a worthwhile argument …"

Hunt, T. (2000). Exploring a new frontier: Beginning teachers' experiences with information technology. *Computers in New Zealand Schools*, 12(3), 37-46.

A survey of student Primary and Early Childhood education teachers seeks to assess their levels of skills and experience, as well as their attitudes towards Information Technology. The survey was gathered data on the degree of use of various technologies in a range of classes, inside and outside of College, and the degree of skill claimed by students in various IT applications, and perceived importance of these applications. The discussion suggests that while this is a group with relatively high access to technology, and relatively good levels of skill in using it, there is still a perceived lack of understanding of how and when to use the technology in the classroom. This is a quantitative study – all data gathering, with the attitudinal survey on the perceived importance of technologies rating on a scale which was then turned into means and standard deviations. All data was gathered using surveys and questionnaires, with all students being issued the data gathering forms, and between 23 and 41% of these being returned. The main comparative analysis tool was a one-way ANOVA.

Lavery, L., Townsend, M., & Wilton, K. (1998). Teaching literacy skills to adults not in paid employment. *N.Z. Journal of Educational Studies*, 33(2), 181-192.

A comparative study of the effect on literacy and numeracy education for a small group of long-term unemployed New Zealand adults is reported. One group was given a 'traditional' teacher-lead literacy course while the other received one-hour sessions using a CCC developed software package. The difference between pre-test and post-test scores in literacy, numeracy and comprehension tests provides the analysis of improved levels of

these skills. This paper claims significant advantages in the use of the CAI intervention. The authors also suggest that a secondary advantage of using CAI is an increased familiarity and confidence in computer literacy. This is a quantitative research study using both multi-variate and univariate analysis.

Liang, A., & McQueen, R.J. (2000). Computer assisted adult interactive

learning in a multi-cultural environment. *Adult Learning,* 11(1), 26-

29.

A case study that involved questionnaires, observation and interviews to examine the learning rates and attitudes to achievement of the participants. The research wanted to determine if there was any relationship between learner characteristics and learning outcomes for the students. The methodology was qualitative, with reporting of themes that emerged from the data collection methods employed.

Maclaren, P., & Shukla, H. (1999). Diversity in course delivery:

Pharmacology 6 offered on campus and in a virtual classroom.

Proceedings of the Ascelite 1999 Responding to Diversity Conference,

Queensland.

This research project was carried out by staff at AUT. A quantitative method with a case study approach was used for this research to examine the effect of a change in the way that a course was delivered and make recommendations for future implementations.

The Pharmacology 6 paper in the Bachelor of Medical Laboratory Science at AUT is offered on campus and in a virtual classroom. Data was collected from Semester 2 1998 on-line students who completed a survey of their experience and a *p* test was done to compare the final course marks of both groups of students. There was no significant difference in course marks between the two groups of students. The research established that the on-line course was an effective method of course delivery and catered to the needs of students who would not otherwise have been able to undertake the course of study.

Malcolm, P. (2000). *Bringing the NZDipBus on-line – Case study.* [CD-ROM]

New Zealand Diploma in Business Conference Proceedings,

Christchurch Polytechnic Institute of Technology.

A case study examining the methodologies employed to select a course authoring tool to provide facilities for on-line content for a programme of study. The tool chosen, Blackboard CourseInfo, is extensively profiled from both student and lecturer points of view. Recommendations from the experience of selection and use are provided, including the need to provide adequate training for both students and staff who expect to use the systems.

Malcolm, P. (2000). *How can we help students succeed with on-line courses?* [CD-ROM] New Zealand Diploma in Business Conference Proceedings, Christchurch Polytechnic Institute of Technology.

Research based on a survey of students to examine opinions about on-line courses offered at UNITEC. The models of on-line materials as reference/research information only, and the use of computers and the Internet to supplement other class activities are examined; the use of web-based courses that take the place of direct student/lecturer contact was not included in the study. While the survey material is analysed quantitatively, the author has also provided qualitative materials relating to the nature of successful students, lecturers and methods of introduction of on-line learning.

Mann, S., & Cowan, K. (2000). Degrees of information technology in New Zealand vocational institutions. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

As many New Zealand polytechnics are now offering computing degrees the researchers from Otago and Christchurch sought to describe common characteristics of polytechnic computing degrees and discover what innovate methods of development and management are being used in these degrees. A qualitative approach was taken with the researchers looking at accreditation documentation as well as publicly available marketing material and papers presented by degree lecturers at New Zealand computing conferences. The research identified that most of the degrees were taught in small classes, had strong links with industry and had a high vocational emphasis. Issues that were highlighted from the investigation were that the content, teaching staff and mode of delivery changes frequently.

McCurdy, D. (2000). Action and emancipation: The flexible assessment

    paradigm. *Proceedings of the 13th National Advisory Committee on*

    Computing Qualifications, Wellington, July, 2000.

    Qualitative research with an action research protocol was used by
    the researcher at UCOL to describe how flexible assessment was
    used in a third year Software Management course. Students were
    permitted to submit their work for assessment at any time during
    the course of study and were permitted to submit their work any
    number of times for feedback. Students had the choice of
    submitting any evidence that satisfied the learning outcome in
    whatever mode they desired. Feedback and evaluation was
    sought from students and lecturers. The researcher concluded
    that the experiment was worthwhile and recommended that it be
    extended to other courses in the final year of a degree.

McFarlane, H. (1997). *A study of 'economics in action': A comparison of*

    computer-assisted instruction use by mature and younger students.

    A Masters project for Applied Computing, Mathematics and Statistics

    Group, Lincoln University, New Zealand. [On-line] Available URL:

    http://www.lincoln.ac.nz/amac/publish/acms/eastudy.htm

    A study to establish whether mature students make more use of
    computer-assisted instruction (CAI). Information was sought on
    the differences between mature and younger students' actual use
    of a CAI package, on their expectations of CAI use, and their
    perceptions of its helpfulness. Students enrolled in a first-year
    economics subject at Lincoln University had "Economics in Action"
    (EA), a CAI package, available to them as a learning resource.
    About five hundred students were enrolled in this class, and
    included a sufficient number of mature students to ensure the
    study was valid. Data collection involved both quantitative and
    qualitative methods.

McLoughlin, C., & Oliver, R. (1998). Meeting the needs of gifted and

    talented students through technology supported distance teaching.

    Australian Journal of Educational Technology, 14(1), 35-48.

    Undertaken in 1997 as a state-funded research project in Western
    Australia, this project seeks to investigate whether audiographic
    conferencing for distance students can encourage higher-order
    learning activities in accelerate groups. The study observed
    teachers in five curriculum areas interacting with their students,
    and categorised the interactions into 7 types – talk, procedural,

control, feedback, cognitive support, and similar. Teachers were then provided with workshops which explored strategies in developing independent thinking skills, and the same observations repeated as in phase 1. Analysis looked at changes in teacher behaviour, and the types of interactions with their students.

While this study concentrated on video recordings and interviews for data gathering, the data analysis was quantitative. Interactions were expressed in categories as a percentage of class time, and patterns of change were easily detected by comparing these percentages. It meets the essential criteria of an Action Research project, in that the study sets out to alter the performance of the teachers it is studying. The conclusion does not investigate the student responses or the affect on the students' learning. It does conclude that higher order learning is possible using audiographics over distance.

Mitrovic, A., & Martin, B. (2000). *Evaluating the effectiveness of feedback in SQL-Tutor*. In J.C. Kinshuk, C. Jesshope, & T. Okamoto (Eds.), Advanced learning technology: design and development issues. Los Alamitos, CA: IEEE Computer Society.

The research compares six methods of feedback provided to students using SQLT-Web (Structured Query Language Tutor program) and compares the effectiveness. The study categorised the six types of feedback available into three groupings, then measured students' responses for accuracy and time taken. The data collected was analysed and presented in a quantitative manner, with conclusions drawn based on the results obtained. Both authors are associated with Canterbury University, and the workshop was held in Palmerston North in December 2000 (http://lttf.ieee.org/iwalt2000/).

Outred, H., Fountain, D., & Wilson, M. (1997). *Using the world wide web and CD-ROMs to produce tutorials.* Institute of Molecular Biosciences, Turitea. [On-line] Available URL: http://quality.massey.ac.nz/IET/Web-Based%20Instruction%20and%20CDs/WBCDOutred97.html

Producing tutorials using the World Wide Web and CD-ROMs to develop and reinforce laboratory and observational skills in a clear and highly interactive format with the goal of providing accessible knowledge to all students on a continuing basis.

Parr, J. (1997). Computer assisted learning with an integrated learning system: Another front for raising literacy and numeracy amongst secondary students? *New Zealand Journal of Educational Studies*, 32(1), 37-51.

This paper examines the response of secondary schools students (Forms 3 to 6) to the CAI software provided by CCC. In three sections of reading, writing and maths, rates of development per hour of exposure are calculated. No comparisons are made with rates of learning of students not using the software. Comparisons are drawn between different sections of the student body, such as on the basis of age, gender and race. The bulk of this research is quantitative, looking at actual rates of gain, and the significance of the comparisons as mentioned above, as calculated by t-tests. Semi-structured interviews were also conducted with many of the students and teachers, and while a sample of these is reported, no analysis is done on the substance of these interviews. While this research has the initial appearance of a qualitative component, no qualitative analysis is attempted.

Paynter, J., & Pearson, M. (1998). *A case study of the web-based information systems development.* Department of Management Science and Information Systems, University of Auckland, New Zealand. [On-line] Available URL: http://cecil.msis.auckland.ac.nz/cecil/pdf/www_Case_Multimedia_98.pdf

A case study describing how software development methodologies are keeping pace with technology. The paper also discusses specific methodologies that may prove useful for developing information for the World Wide Web.

Paynter, J., & Sheridan, D. (1998). *Using the internet to teach software engineering.* Department of Management Science and Information Systems, University of Auckland, New Zealand. [On-line] Available URL: http://cecil.msis.auckland.ac.nz/cecil/pdf/CSL_SEEP_98_d.pdf

The development of CSL (Computer Supported Learning) and its use in teaching software engineering courses. Presentation of the lessons learnt together with ongoing implications for self-directed study and life-long learning.

Powell, P. (1998). Rural teachers' computer encounters: A different experience? *Computers in New Zealand Schools*, 10(2), 17-22.

A study of teachers in a rural school district looks for common barriers to the further and more productive use of IT by classroom teachers. Of 53 teachers initially surveyed by questionnaire, 33 responded, and of these 33, six were identified for further interviews and discussion. The survey identified eight different barriers to increasing IT use, and the subsequent interviews rated the number of times (methods) that teachers suggested for overcoming these barriers. Powell reports a strong belief amongst the 33 respondents that computers are beneficial to education, even though many are relatively new to computer use. He does not suggest that those more negative about computers in education may have been less likely to respond in the first place.

This is a quantitative research study, based on surveys and interviews. Data gathered refers mainly to the specific categories of barrier and individual opinions of removing those barriers.

Putterill, M. (1999). *Brighter, bolder but is it better? – The perennial course design dilemma.* Proceedings of the Fifth Australian World Wide Web Conference, Southern Cross University, NSW, Australia. [On-line] Available URL:

http://ausweb.scu.edu.au/aw99/papers/putterill/paper.html

The paper recognises the importance of three elements in Asynchronous Learning Networks (ALN) course design and delivery: access, process and process–efficiency, and content–quality. Analysing distance learning developments in the tertiary sector, the author concludes that there is an over emphasis on widening access to courses and process efficiency is leading to lower content quality. The danger that ALN will not live up to its great potential, and become uniform, prompts a call for the development of a balanced framework which reflects these three related elements. This framework is used to describe characteristics of three exemplary web–based projects used in tertiary and post–tertiary education. The paper concludes by drawing attention to the need to side–step the trap of uniformity, by engaging in the preparation of Peak Learning Experience courses.

Reinhard, K. (1997). *Image analysis and object surfaces.* Tech Report CS-TR-152 / CITR-TR-9, University of Auckland, New Zealand. [On-line] Available URL:

http://www.citr.auckland.ac.nz/research/techreports/CITR-TR-9.pdf

A quantitative paper that illustrates a few recently achieved practical results in computer vision (some obtained at CITR Tamaki) and briefly discusses directions in research.

Rimoni, R. (1999). Evaluating performance using software. In M.S. Brown (Ed.), *Proceedings (volume 4) - "Getting together" Learning Support and Development Conference* (pp. 21-25). Hamilton: Teaching and Learning Development Unit.

This a report on a trail using software in the evaluation and feedback processes involving students using the Manukau Institute of Technology's Learning Centre. Some numerical outcomes of the trial are provided, but the intent was not to conduct experimental research, but rather to convey the impressions of those who took part in the trial. Some attempt was made to contrast in general terms the previous (manual) evaluation process to the new computer-based method. There was some confusion in the presentation of material, with some portions relating to the pilot trial of the evaluation process, and some to the actual responses from the students regarding their perception of the Learning Centre. The commentary was of a qualitative nature, drawn out through the administration of the surveys to the students.

Robertson, G., & Holdsworth, R. (2000). Help desk: Providing students with real-life experiences. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

A Help desk course run at Waikato Polytech aims to provide students with real-life situations where students are exposed to the same pressures they would encounter in the workplace. The researchers at Waikato Polytech were involved with teaching the course and used a case study approach with qualitative methods including observation and questionnaires to determine the outcomes of students' experiences. They concluded that students' experiences were positive and that the experience that students gained would be of great benefit to them.

Ross, J. (2000). Aptitude testing as a predictor of success: The Christchurch experience. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

The researcher used quantitative analysis and *ex post facto* research to compare aptitude test results with subsequent performance of students enrolled in the Certificate in Business Computing at Christchurch Polytech. Course grades and aptitude test results were grouped and presented in a graphical format. The statistical significance of each part of the aptitude test and the final grades was calculated. The conclusion was that, providing the student had passed the aptitude test, there was little significance between the aptitude test results and the course grade.

Sheridan, D., & Tan, F. (1998). *Using the internet to support learning: Implications for administration, assessment and instruction.* Department of Management Science and Information Systems, University of Auckland, New Zealand. [On-line] Available URL: http://cecil.msis.auckland.ac.nz/cecil/pdf/Internet%20&%20Learning .pdf

Qualitative study of the benefits of building a link between online assessments and knowledge elements.

Sherry, C. (2000). *150 computer concepts for the new millennium.* [CD-ROM] New Zealand Diploma in Business Conference Proceedings, Christchurch Polytechnic Institute of Technology.

This report describes the re-design of a course delivered with a combination of live and on-line resources. The integration of Problem Based Learning (PBL), Collaborative Learning and Resource Based Learning (RBL) is described, along with the authoring tools used to provide the materials for the students. Some quantitative reporting is done based on data collected in a questionnaire, but the research is for the most part qualitative and descriptive.

Smith, A. (1997). Testing the surf: criteria for evaluating internet information resources. *The Public-Access Computer Systems Review*, 8(3), 33-38.

This paper looks at ways in which the credibility and worth of world-wide web sites can be measured by users. The study looked at 26 separate features of web pages, from currency, scope, authority, and other features related to user friendliness and graphic design. The author then determined which of these features was mentioned in criteria proposed by a number of search engines, ratings sites, information clearing houses. Analysis pointed to some specific features being more universally 'valued' than others according to the frequency of mention.

This is essentially a quantitative data gathering exercise, with very little analysis or interpretation – more of a fact-finding mission.

Steele, A. (2000). Promoting student interaction in a flexible delivery environment. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

The researcher at UCOL had observed that flexible delivery restricts student interaction for learning and socialization. Qualitative research with an action research protocol was used by the researcher to determine the best methods of developing and increasing student interaction. Data was collected from questionnaires, observation and interviews. Orientation ice-breaker exercises were used initially and feedback from students and lecturers throughout the semester provided other methods of increasing interaction. Students and lecturers agreed that the methods implemented w   ere successful. Further methods were to be implemented and evaluated in subsequent semesters.

Sterling, D. (1999). *Development of material for teaching statistics based on a web browser and java.* Institute of Information Sciences and Technology, Turitea. [On-line] Available URL: http://quality.massey.ac.nz/IET/Web-Based%20Instruction%20and%20CDs/WBCDStirling99.html

Report on the processes used to develop and trial a computer-based textbook to combine textual instruction with interactive diagrams and animations to help teach specific concepts. The material will cover all topics in an introductory statistics course and will include nearly 200 interactive diagrams. This type of material is particularly appropriate for extramural learning. However it can also allow internal students to do their initial learning of statistics on a computer with lectures providing additional motivation, examples and overviews.

Sutcliffe, R., & Kuypers, G. (2000). Success factors of student projects from

> hosts' perspective. *Proceedings of the 13th National Advisory*
>
> *Committee on Computing Qualifications, Wellington, July, 2000.*
>
> Many tertiary institutes require students to complete an industry
> based project in a host organization. The researchers at the
> Central Institute of Technology used a case study approach with
> quantitative method with a telephone and postal survey to identify
> the success factors of students' projects from the hosts
> perspective. The most critical factor in delivery a successful
> project is that the user requirements are clearly defined and that
> these requirements are present in the delivered product. From a
> very small sample of 15 organisations the researchers concluded
> that host organizations are generally satisfied with the outcome of
> student projects and are reasonably understanding when the
> projects are not successful.

Swanepoel, S. (2000). Making homework educationally sound: Encouraging

> the use of ICT tools for authentic learning at home – A case study.
>
> Computers in New Zealand Schools, 12(1), 27-32.
>
> This is a report of an Action Research project which aims to assess
> Primary students' response to a change to greater use of ICT in
> their homework tasks. Students were given more autonomy in
> selecting their own homework tasks, and were to develop a
> hypermedia presentation of their completed project to their
> classmates. Students who did not have access to ICT tools at
> home were given class time to complete this task. Reports and
> discussion indicate that the ability to choose their own research
> topics played a large part in increased enthusiasm and completion
> rates. The action research is complemented by two case studies
> of students from different backgrounds. This qualitative research
> uses a combination of Action Research and case studies. The
> conclusion and discussion reports impressions and opinions on the
> effectiveness of the project.

Vargo, J. (1997). *Evaluating the effectiveness of internet delivered*

> *coursework.* Conference Paper, Southern Cross University, Australia.
>
> [On-line] Available URL:
>
> *http://www.afis.canterbury.ac.nz/jvpaper1.htm*
>
> Do interactive instructional method technologies really provide a
> pedagogically sound foundation on which to build more effective
> (as well as efficient) educational programmes? This paper reports

on work-in-progress, including a summary of literature and a synthesis of aspects of effective education which may be supported by Internet based technologies. Also included is early work on constructing a course module to test the hypothesis that this technology will increase instructional effectiveness.

Vargo, J. (1998). *Using information technology in teaching.* Department of Accounting, Finance and Information Systems, Canterbury University, New Zealand. [On-line] Available URL: http://www.canterbury.ac.nz/publish/research/98/using.htm

The research involves a series of case study experiments with two large university courses, one in Accounting and the other in Information Systems. Some students have used WWW-based tutorials for learning a portion of the course while others have had traditional discussion tutorials. The work is based on learning theory in higher education and includes the testing of a theory of student engagement using a WWW-based learning system. This experimental and case-based research includes a careful design to triangulate outcomes, including quantitative data based on a controlled experimental design with a pre-test/post-test survey of both treatment and control groups, together with observation, interview and focus-group generated qualitative data.

Viskovic, A., Purnell, S. & Evans, N. (1999). Three cultures? Face-to-face, distance and on-line learning. In N. Zepke & M. Knight (Eds.), *Adult learning cultures* (pp. 124-140). Wellington: Wellington Polytechnic.

Two students and a lecturer describe experiences of distance and face-to-face modes of learning for a BEd programme for adult educators, and comment on the future of on-line learning. The study provides observations and reflections. The results of a student survey are included to quantify access and interest in on-line learning, but most of the findings are presented in a qualitative manner. The conclusion provides a series of questions that arose for each of the three contributors in attempting to identify future directions for study and consideration.

Wieck, M. (2000). Workplace assessment – Balancing the needs of student and organization. *Proceedings of the 13th National Advisory Committee on Computing Qualifications, Wellington, July, 2000.*

A case study was conducted by the researcher at Christchurch Polytech to examine conflicts of interest between students and employers in a cooperative education project. Using Alexander's patterns framework the researcher sought to resolve these conflicts. Qualitative data was collected from students and employers who were interviewed or completed questionnaires about the cooperative learning experience. The pattern framework identified a number of common problems and provided solutions that will be shared with future students, lecturers and employers.

11   Tabular Analysis of Annotated Bibliography of Research

1st Author	Year	Ed Level	Paradigm	Methodology	Data Collection	Data Analysis
Burbules	1997	Mixed	Interpretive	Qualitative	Literature review	Interpretation
Crump	2000	Tertiary	Mixed	Mixed	Survey, Likert scale	Counts, percentages
Dewstow	2000	Tertiary	Normative	Quantitative	Questionnaires, interviews	Means, counts
Falloon	1999	Secondary	Interpretive	Qualitative	Observations, interviews	No specific analysis
Ferguson	2000	Tertiary	Normative	Quantitative	Enrolment data vs performance	Percentages, p-test
Fleming	2000	Tertiary	Mixed	Mixed	Surveys, interviews	Counts, percentages
Foley	1998	Tertiary	Normative	Quantitative	Surveys, journals, open questions	Triangulation
Halliday	2000	Secondary	Normative	Quantitative	Surveys	Percentages, means
Herrington	1997	Tertiary	Interpretive	Qualitative	Observation, interviews	NUDIST
Housego	2000	Tertiary	Interpretive	Qualitative	Case Studies	No specific analysis
Hunt	2000	Tertiary	Normative	Quantitative	Surveys	ANOVA
Lavery	1998	Adult	Normative	Experimental	Pre-test and Post-test scores	Mulit-variate and univariate analysis
Liang	2000	Adult	Normative	Qualitative	Questionnaires, observations, interviews	Thematic, but not quantified
Maclaren	1999	Tertiary	Normative	Quantitative	Case study	p-test

Malcolm (a)	2000	Tertiary	Interpretive	Qualitative	Case studies	No specific analysis
Malcolm (b)	2000	Tertiary	Normative	Mixed	Survey	Percentages
Mann	2000	Tertiary	Normative	Qualitative	Questionnaire	None – responses categorised and discussed
McCurdy	2000	Tertiary	Normative	Qualitative	Action research	None – observation of results of action
McFarlane	1997	Tertiary	Interpretive	Mixed	Surveys	Percentages
McLoughlin	1998	Secondary	Normative	Quantitative	Observation, action research	Percentages
Mitrovic	2000	Tertiary	Normative	Quantitative	Surveys	Percentages, correlation
Outred	1997	Tertiary	Interpretive	Mixed	Observation, action research	None – observation of results of action
Parr	1997	Secondary	Normative	Quantitative	Test results, semi-structured interviews	t-test
Paynter (a)	1998	Tertiary	Interpretive	Qualitative	Case study	Descriptive, cross-case
Paynter (b)	1998	Tertiary	Normative	Quantitative	Action research, quizzes, multichoice tests	Counts, percentages
Powell	1998	Primary	Normative	Quantitative	Surveys, interviews	Percentages
Putterill	1999	Tertiary	Interpretive	Qualitative	Case study	Cross-case
Reinhard	1997	Tertiary	Normative	Quantitative	Action research	Counts, percentages
Rimoni	1999	Tertiary	Interpretive	Qualitative	surveys	Minimal analysis by percentages
Robertson	2000	Tertiary	Normative	Qualitative	Case study, observation, questionnaires	Counts
Ross	2000	Tertiary	Normative	Quantitative	Aptitude test vs performance	Percentages, grouping into bands, statistical significance
Sheridan	1998	Tertiary	Interpretive	Qualitative	Action research, observation, tests	Counts, percentages
Sherry	2000	Tertiary	Interpretive	Qualitative	Questionnaire	Percentages, interpretive
Smith	1997		Normative	Quantitative	Categorizing of responses	
Steele	2000	Tertiary	Normative	Qualitative	Questionnaires, interviews, observation	Percentages
Stirling	1999	Tertiary	Normative	Quantitative	Tests	Counts, percentages
Sutcliffe	2000	Tertiary	Normative	Quantitative	Surveys	Percentages, counts
Swanepoel	2000	Primary	Normative	Qualitative	Action research, case studies	Impression, opinion

Vargo (a)	1997	Tertiary	Interpretive	Qualitative	Literature review	Percentages, comparison
Vargo (b)	1998	Tertiary	Normative	Experimental	Controlled experiment, surveys, interviews, case studies, observation	Triangulation
Viskovic	1999	Tertiary	Normative	Qualitative	Survey, interviews	Personal recommendations
Wieck	2000	Tertiary	Normative	Qualitative	Interviews, questionnaires	Analysis of responses to form patterns (i.e. attempted to group similar narrative responses)