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Students' Conceptions of Research. I: A qualitative and quantitative analysis

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Relatively little is known about students' conceptions of research and, in particular, whether there are conceptually discrete patterns of variation that can be used to model this phenomenon in terms of research-as-learning outcomes. The present study explores the dimensionality of students' conceptions of research from two complementary research perspectives. The open-ended written responses of students (n=154) to questions aimed at soliciting variations in conceptions of what research is are analysed using a qualitative methodology to isolate "categories of description". Findings are summarized in terms of eight such main categories, some of which are further internally differentiated. In terms of the main categories, research is conceived in terms of (variation in): (A) information gathering, (B) discovering the truth, (C) insightful exploration and discovery, (D) analytic and systematic enquiry, (E) incompleteness, (F) re-examining existing knowledge, (G) problem-based activity, and (H) a set of misconceptions. The substantive verbatim excerpts that formed the units of analysis in the qualitative analysis were used as a basis for item stems which were psychometrically operationalized into a Students' Conceptions of Research Inventory (SCoRI). This inventory was administered to a second heterogeneous sample of postgraduate students (n=224) and the resultant data were subjected to exploratory factor analyses that provided empirical support (as dimensions of variation) for a smaller subset of the categories isolated in the qualitative analysis. Empirically, and in terms of additional psychometric considerations, there was support for five dimensions of variation (common factors) in terms of categories B, C, F, G, and H. These findings provide an initial conceptual basis for interpreting how students engaged in research activity may differ from one another in terms of their conceptions, as well as what the likely consequences of any such stable differences may be for research-as-learning outcomes.

Keywords: *Conceptions of research; Modelling learning outcomes; Research as learning*

Introduction

Postgraduate research is an expensive enterprise. In recent years governments have articulated a growing concern about the cost of postgraduate education and,

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compared with undergraduates, associated factors such as high attrition rates (Association of American Universities, 1998; Higher Education Funding Council for England, 1999; Kemp, 1999). Modelling the factors that effect postgraduate completion rates in various differentiated contexts could have important economic implications for both tertiary institutions and the education sector.

The present study sketches in two parts the first stage of a research programme that has as one of its aims the construction of an empirical model of students' conceptions of research, a statistical process that is essentially concerned with isolating and psychometrically operationalizing conceptually discrete sources of explanatory variation. The expectation is that such sources of variation (treated here as observables or "variables"), augmented at a later stage by additional observables that, for example, capture variation in terms of research processes, can be used to model research-based learning outcomes.

There is a conceptual comparison that can be drawn here between the research programme thus broadly outlined and the well-established literature on student learning. The comparison reflects the fact that research-based outcomes (like learning outcomes) are produced by cognitive processes, the quality of which are likely to be influenced by factors internal and external to the students involved. In general modelling terms these processes substantively represent the mechanisms of production of the outcomes that are of interest. However, these processes are not isolated independent entities in modelling terms; they may, for example, be influenced by other factors, such as motivation and prior knowledge.

From everyday experience it is self-evident that research students may, for example, be intrinsically, extrinsically, or strategically motivated and that they are likely to orchestrate their research activities accordingly. This is also true in terms of their respective conceptualizations of what "research" is, how it is (or should be) conducted, and, therefore, how it is likely to be initially approached. Conceptually, then, it seems reasonable to argue that the quality of research engagement in process, affective, and discourse terms is initially likely to be quite fundamentally mediated by students' prior knowledge of research; their temporal understandings, thoughts or beliefs about what "research" is, how it is carried out, and for what purpose(s). Such conceptions, representing perhaps explicit forms of declarative or procedural prior knowledge, are the filters through which students are initially likely to perceive and, accordingly, engage both the context and the content of research. The analogy here with the student learning research literature is in terms of the classic study by Van Rossum and Schenck (1984), who demonstrated the relationship between conceptions of learning and approaches to learning; basically, that students with transformational conceptions of learning were more likely to adopt a "deep" approach to learning than students with accumulative conceptions.

More generally, and in terms of intrinsic factors, it is likely that research students will differ from one another in terms of the classic generic sources or (families) of explanatory variation associated with student learning, such as motivation, intention, processes, self-regulation, prior knowledge (within which conceptions of research are

foregrounded here), and perceptions of the research environment and its embedded task demands.

In also drawing attention to the well-established research literature on conceptions of learning (and teaching), Brew (2001, p. 271) pointed out that "conceptions of research have rarely been a subject for investigation, and empirical work on the ways in which research is experienced by those who undertake it is hard to find". Common to many of the phenomenographic studies in the literature on "conceptions" is the theorization that a "conception" of some phenomenon reflects (variation in) individuals' experiences and development of an understanding of that same phenomenon in specific contexts. Svensson (1997, p. 163), for example, referred to students' expressed knowledge, described as conceptions, as "meanings and understandings of phenomena". Various dictionary definitions of "conception" also provide useful qualifications in terms such as, for example, (the act of) "apprehension" or "imagination" (Shorter Oxford Dictionary) or "an idea of what something … is like" (Cambridge Advanced Learners Dictionary). And in drawing upon these perhaps episodic acts there may thus emerge a more generalized conception of the phenomenon as an aspect of experience. For the purposes of the present study conceptions of research are thus reflected as (variation in) the contextualized beliefs, ideas, or understandings of postgraduate students who are actually engaged in various forms of research.

A Qualitative Analysis

Sample and Methods

Australian and South African postgraduate students from a variety of discipline backgrounds (n=154) provided written open-ended responses to the following statements.

- As an open question, how would you explain to a stranger what "research" is?
- To now be more specific, write down what you think "research" means in your discipline or subject.
- What do you think the main reasons are for doing "research" in your discipline or subject?
- Could you now describe what you think successful researchers actually do in your discipline or subject.
- What do you think constitutes "good research" in your discipline or subject?

Analysis of the resultant data was approached without any preconceived ideas about what the internal structure of the data might or should look like. In fact a (perhaps to some readers) strange feature of the present study is that it proceeded from a researchable question in the absence of any explicit knowledge of what findings already exist in the research literature about students' conceptions of research. Methodologically there was thus no need to consciously attempt to

"bracket out" any preconceived ideas about what the qualitative analysis might reveal.

The qualitative analysis (carried out by the first author) commenced with a reading of all the written responses as whole cases, rather than as compartmentalized segments according to the questions asked, to form a first impression of emerging individual differences and the conceptual boundaries that might be used to separate or aggregate them thematically. In the second stage of the analysis the sub-domains of such themes were provisionally mapped out in terms of verbatim extracts of what students had written; it was at this stage that the "individual voices" (or case identities) in the data were lost. It was anticipated that insofar as conceptually discrete aspects of these extracts constituted qualitative "units of analysis", they would at a later stage be amenable to psychometric operationalization via the construction of inventory item stems.

This process of reading the full transcripts, recording extracts (with decreasing frequency), and provisional mapping, was performed three times, followed by two grouping iterations of the extracts themselves. These grouping iterations were aimed at minimizing the variation within and maximizing the variation between emerging themes (the common pools of meaning) constituted in terms of the verbatim extracts within the sub-domains.

Findings

The Appendix reports the emergent categories and associated sub-categories (italic subheadings) that emerged. All statements are presented exclusively in terms of verbatim excerpts. Numbers in brackets identify the source of the excerpt by case number.

Interim Discussion

The purpose of the qualitative analysis was two-fold; to establish whether qualitative variation was present in the data and, if so, whether the variation could be interpreted in terms of an underlying conceptual structure that might inform further empirical (statistical) modelling.

The qualitative variation in the data captured in the Appendix supports an interpretation in terms of at least eight conceptually discrete dimensions of variation (categories), with finer conceptual distinctions suggested within some of them. An open question is whether these categories might be further clarified and/or augmented in the light of further qualitative analyses grounded in other response contexts. However, even in their present form, and to the degree that they may be thought of (either singly or in combination) as representing dimensions within which "real people" might vary, the insights provided by these categories are clearly of import. It is not possible in the present case to present an explanation of these

dimensions in terms of the theoretical literature for no such acknowledged literature (on student's conceptions of research) appears to exist.

The present findings might begin to illuminate everyday supervisory experiences such as novice would-be researchers enrolled on research methodology courses who find it difficult, at least in the initial phases of such courses, to conceptualize the architecture of research enquiry. There are many novice research students who, for example, are apparently incapable of distinguishing between descriptive, interpretive, and analytical processes. Furthermore, even some masters and doctoral students embarking on quantitative work appear unable to formulate original research questions outside the limiting "toolbox mentality" framework of questions that are readily answerable using standard statistical software packages. Simply put, the conjecture to be addressed in future work is that variation in conceptions of research is likely to constitute a number of mindsets through which perceptions of the (research) learning environment are differentially filtered in a congruent manner likely to influence the quality of research engagement.

The next part of the present study explores the degree to which the exhibited qualitative dimensions of variation, dimensions within which students may differ from one another, have been psychometrically operationalized at an item level based on the disclosed excerpts.

A Quantitative Analysis

Introduction

The research question here is whether the conceptually discrete, but not necessarily conceptually independent, qualitative dimensions of variation suggested by the analysis presented above also represent sources of variation in a statistical sense, the latter requirement being essential for quantitative modelling purposes.

Apart from the analysis already presented, and the item stems derived therefrom, three concurrent analyses of the same set of open-ended response data were carried out independently by the second author (Shanahan), as well as by two other collaborating colleagues.[1] A product of this second group of finer-grained analyses was an additional set of potential item stems reflecting further nuances of variation in the data within the demarcated qualitative dimensions already described.

The procedure followed was to transform wherever possible discreet aspects of what students had written about research (in sometimes quite complex sentences) into simpler statements intended to communicate just one aspect of the whole. Original wording was retained wherever possible and, at the same time, alternative expressions were generated in varying degrees of nuance to allow the possibility of ultimately selecting those items exhibiting the best psychometric characteristics. Items thus generated were individually operationalized using a standard 5-way Likert-type response metric constituted in terms of a neutral position plus two degrees of intensity of agreement and disagreement, respectively. The first

exploratory version of the Students' Conceptions of Research Inventory (SCoRI) comprising 124 items was thus constituted.

It is emphasized that the domain of the first version of the SCoRI thus constituted is substantively grounded in students' conceptions of research. The theoretical rationale for the domain thus proceeds from a "grounded theory" sense rather than a consideration of existing theory or empirical evidence. It is also the case that not much is known about how students vary in their conceptions of research and how it should be conducted; in fact, the present authors are not aware of any other empirical studies on this topic.

The Sample

The SCoRI was presented to a fresh and independent sample of students in two formats; in printed form and as a web page that allowed online electronic data capture. Attention was drawn to the latter facility informally and via some networks, with an invitation for colleagues to encourage their students to respond. A total of 246 responses were obtained, 22 of which were discarded because they were either repeat transmissions or corrupted due to interrupts during electronic submission. The remaining usable data ($n=224$) form the basis of the analyses that follow.

Before discussing the results obtained from the undifferentiated inventory responses, a profile of the students themselves is presented. Respondents were from two countries: of the 224 responses, almost 65% of the students were currently studying in Australia, while just fewer than 35% were from South Africa.[2] In two cases no such information was provided. Nineteen responses came from undergraduates (where students doing an "honours" year were classified as undergraduates) and the remainder (92%) were postgraduates. Just fewer than 40% of the postgraduates were in their first year, 26% in their second year, and 10% in their third year of postgraduate studies. The remaining 24% were in their fourth or later year of study or did not respond to this question.

About a quarter of the students were engaged in coursework masters degrees, while 11% were completing a masters by research. The single largest group, more than four out over every 10 respondents, was undertaking a Ph.D. by research. This group comprises those who stated they were studying for a Ph.D. "by research" (about a quarter of all respondents) and those who responded they were doing a "doctorate" (almost another 20%). The remaining postgraduate students were enrolled in a mix of graduate diplomas, Ph.D. qualifying studies (almost 8%), graduate certificates, M.Phil., and so forth.

Overall, almost half the students who responded indicated they were conducting research in the social sciences, while the other half were researching in the physical sciences. The single largest group (40 responses or almost 18%) was studying development studies (classified here as a social science) in South Africa, while the remainder was in both the physical and social sciences. Among the Australia-based students, 60% and 40% were in the physical and social sciences, respectively. The

particular discipline areas of respondents were quite diverse, including, for example, textiles, sculpture, foetal physiology, music composition, colloid chemistry, children's literature, and public finance.[3]

Just over half of the students were doing their post-graduate study at the same university as they did their undergraduate study. Although almost 46% of students completed undergraduate studies in Australia and a further one-third in South Africa, about 13% completed undergraduate studies in a total of 16 other countries. Of these 16 countries, the UK, China, and Thailand contributed 4.4 of the 13%.

Just over half (57%) of the students were female and a similar percentage (55%) had English as their first language. Only one-third of students had no immediate family member who had previously studied at university. A large proportion (32%) stated that they had previously won academic prizes and a similar proportion (38%) had previously published academic work. Given these responses it is perhaps not surprising that one quarter thought their thesis would be rated as excellent ("near the top of all dissertations and an important piece of work for all future researchers") and that a further 45% believed their work would be very good ("better than average"). Only 16% thought that they would have an average pass ("OK, a pass") or barely pass ("just scrape through") and only eight students (3%) believed their thesis would fail.

In summary (see Table 1), the respondents mostly comprised either Australian or South African postgraduate students, with the profile being weighted toward females, students for whom English was a first language, and a third of whom were former academic prize winners with some record of successfully publishing academic work. Furthermore, most respondents had an immediate family member who had attended university, and the vast majority believed their thesis would be very good or excellent. With this heterogeneous student profile in mind, the quantitative analyses of the inventory responses are now considered.

Methodology and Findings

In essence, the responses were subjected to standard analytical procedures used to develop inventory domains such as, for example, factor analysis to reduce the dimensionality of the data and subsequent item correlation analysis (coupled with distributional considerations) to determine the reliabilities of any emergent and conceptually discrete dimensions of variation.

Apart from the need to isolate empirical structure(s), an immediate and inevitable problem in analysing data of this nature lies in the fact that there are many items, present in varying degrees of conceptual redundancy (arising from alternative wordings of items), that need to be both conceptually sifted and psychometrically assessed. In the first stage of inventory construction this conceptual item redundancy inevitably exaggerates the dimensionality of, and replicates aspects of, any underlying factor structure and it is therefore inappropriate to apply a strict eigenvalue >1 factor extraction criterion. With this expectation in mind, two exploratory

Table 1. Selected characteristics of SCoRI respondents, 2001 (n=224)

		Percentage
Present country	Australia	64.6
	South Africa	34.6
	No information	0.8
Current status	Undergraduate ("honours")	8.5
	Post-graduate	91.5
Country in which undergraduate study was completed	Australia	45.9
	South Africa	33.7
	China	1.6
	Thailand	1.6
	UK	1.2
	Other English-speaking country	3.5
	Other non-English-speaking country	4.4
	Incomplete	8.1
Postgraduate and undergraduate study	Completed at same university	39.0
	Completed at a different university	52.4
	No information	8.5
Field of postgraduate research	Social sciences	48.8
	Physical sciences	47.1
	No information	4.1
Gender	Female	57.3
	Male	42.7
First language	English	55.3
	Not English	44.7
Immediate family	Previously attended university	66.3
	None previously at university	33.7
Academic prizes	Previously won	32.5
	Never won	67.5
Other postgraduate study	Previously completed (e.g. Masters)	43.9
	Not previously completed	47.6
	No information	8.5

(maximum likelihood) factor analyses were carried out using squared multiple correlations as communality estimates.

The first voluminous analysis (not presented) was performed in the conventional manner, using as input the entire set of 124 item-based responses (n=224). A six factor solution was indicated on the basis of the scree plot and a varimax rotation was examined with two purposes in mind; first, to eliminate by inspection non-discriminating items on the basis of cross-factor loadings of compromising same sign magnitude (loadings with absolute magnitudes approximately >0.25) and, second, to conceptually interpret any underlying empirical structure(s). The six factors, in order of extraction, were conceptually labelled as (F1) misconceptions about research, (F2) re-search, (F3) insightful process, (F4) finding solutions to problems, (F5) discovering the truth, and (F6) gathering information.

The second factor analysis was based on a reduced item pool of 69 item-based responses (n=224) resulting from the elimination of items with cross-factor loadings identified in the first analysis described above. A six factor solution, presented in full in Table 2, was again indicated by the scree plot and was retained for

Table 2. Varimax factor structure (n=224)

	F1	F2	F3	F4	F5	F6
Factor 1. Misconceptions about research (α=85) (bold items)						
Good research specifically gathers data that will support the researcher's preconceived ideas	**71**	12	3	2	0	−17
Research becomes true after it is published	**68**	13	0	2	7	13
If followed correctly research procedures will always yield positive results	**66**	9	3	14	−2	−17
When qualified people do research the results are always unbiased	**64**	6	2	11	1	21
Research is about collecting data which back your argument	**62**	12	23	5	17	−1
Research always means conducting an experiment to test a hypothesis	60	21	2	8	25	1
It is quite acceptable to modify research data if it does not look exactly right	**59**	24	5	−5	−3	−21
Research is exclusively about relating theory to practice	58	28	−1	8	9	−21
There is generally only one way to interpret research findings	**56**	4	1	6	14	18
If research is properly conducted then contradictory research findings will never occur	**55**	−2	−2	18	2	2
Research means finding a definitive answer to specific questions	55	14	9	26	27	−12
For something to be called 'research' it must involve experimentation	55	10	−15	3	10	11
Research is defined as nothing more than finding information in a scientific way	54	7	−2	20	20	−12
Searching again for information that could previously have been found is what research is mainly about	54	42	1	6	−9	−5
Research is just simply data collection	51	27	−2	8	2	−5
Qualitative research is very biased compared with quantitative research	44	5	9	18	4	9
The main purpose of research is to identify problems	44	19	−1	−6	19	−4
Analysing factual information is mainly what research is about	43	24	16	18	15	1
There is basically only one way to do research	41	6	−6	8	11	7
General observation is basically what research activity is about	40	10	−2	−1	10	−10
Research means investigating the quality of something	40	31	11	9	21	−18
Research that is not scientific is not real research	39	−7	−4	20	8	−1
Doing research is like solving a puzzle; the pieces of information logically fit together and the puzzle seems fairly complete	34	19	22	12	12	−14
Once the truth about something is known there is no need for further research	26	−3	−10	21	9	0
There is a cascade effect in answering or understanding something; many other areas present themselves for further investigation	−47	1	34	2	5	26
Factor 2. Research is re-search (α=83) (bold items)						
Research is basically about comparison; new and previous results are compared	18	**65**	6	15	19	5
Research means finding out more information about something that is already there	4	**65**	22	13	20	−9
Research is a systematic investigation to find out if there are facts that were left out by previous researchers	22	**59**	11	19	35	1
Research is there to challenge research that has been done before	10	**54**	12	5	15	20
It is important to do research to verify what is already known	14	54	4	3	−2	−22
Research means finding out facts left out by early researchers; information not considered in past research	19	**50**	21	28	18	14
Research is essentially about discovering something that already exists, but is hidden	15	**49**	11	15	7	9
Research means using findings to reinterpret what is already known	19	**48**	14	9	12	−5

Table 2. (*Continued.*)

	F1	F2	F3	F4	F5	F6
Research is the examination of old things in new ways rather than about discovering new things	22	43	6	−2	−1	4
Research is simply about unveiling what is already there	9	43	8	12	11	−2
Sometimes when doing research the pieces of information don't fit together and you need to study further and look for the pieces you need to complete the puzzle	−5	30	15	11	−7	−2
Research is always based on questions that are asked first	14	26	1	4	17	13
Doing research is the only way to develop theory	12	18	16	16	14	13
Factor 3. Research is an insightful process (α=85) (bold items)						
Research extends current concepts to obtain a better understanding	−6	4	**71**	6	15	−17
Research provides a deeper insight and understanding of a particular topic	−5	−3	**70**	13	7	−27
Research stimulates further interest or work in the area	4	4	**59**	4	4	15
Even the newest ideas germinate in a fertile bed of previous knowledge and ideas	−0	16	**59**	12	2	13
Research means searching for more knowledge in a particular field; to accumulate more knowledge	9	26	**58**	11	10	5
Research summarizes existing knowledge and/or new knowledge to create previously unknown insights	1	19	**56**	4	11	−0
Research is defined as a mechanism to add more knowledge to existing knowledge	14	13	**49**	0	14	−6
Ongoing research raises new questions and thus creates new research	−11	21	44	−6	5	5
Research means studying a particular subject of interest in depth	−23	−3	44	5	15	21
The understanding of researched phenomena is the basis for new technologies	18	2	38	7	16	14
Research is something you do when you want to find information	5	9	30	11	12	−10
There is no beginning or ending to research; there is always something new to study	−10	13	30	4	−1	21
Factor 4. Research is finding the truth (α=89) (bold items)						
Research is fundamentally about finding the truth	33	14	9	**75**	16	−13
Basically research is concerned with uncovering the truth	6	17	4	73	12	20
Research is the quest for truth	30	22	24	**71**	13	2
Research is a process through which the truth is uncovered	11	22	8	**69**	24	19
Research is about exhuming the truth	15	38	18	**59**	18	−7
Research means a systematic hunting for truths about a subject	19	24	22	**56**	21	−8
Research is done in order to determine the truth or validity about something	22	32	21	**54**	29	−17
Factor 5. Research about problem solution (α=80) (bold items)						
Research is about finding solutions to problems	17	13	6	13	**69**	−9
Research is about finding solutions to stated problems	21	28	13	8	**69**	−19
Research means collecting data to solve particular problems	20	23	5	18	**68**	−19
Research is basically a tool for answering questions	19	9	14	11	**54**	−0
Research is the careful and thorough study of a problem	−12	8	31	17	**43**	4
Research means investigating and trying to prove whether a new idea is correct	19	19	22	13	38	14
Research means finding out specific information about an unknown subject	21	14	27	11	37	−4
Research means discovering something which was not known before	13	−0	18	27	37	9
Research always begins with a question	3	2	9	6	28	10

Table 2. (*Continued.*)

	F1	F2	F3	F4	F5	F6
Factor 6. No conceptual interpretation attempted						
Researching a particular topic can never be complete	−32	23	24	0	−6	39
The information, techniques, and perspectives which flow from research affect the way in which problems are perceived	−21	−2	22	3	−5	29
Qualified people do not need permission to do research	11	−1	−18	16	−4	20

Note. Factor extraction is maximum likelihood using squared multiple correlations as communality estimates. All coefficients are multiplied by 100 and rounded up.

interpretive purposes. The first three factors were again respectively constituted in terms of variation in misconceptions, re-search, and insight, followed by truth and solutions (the latter two factors now emerging in reverse order compared with the first analysis). The sixth factor appeared to be a statistical artefact on which only three conceptually unconnected items loaded with an absolute magnitude >0.25.

In both analyses the six factor solutions were thus readily interpretable within a common, within-factor, conceptual overlap in terms of five of the six factors. This commonality, or overlap, was further psychometrically refined (based on the within-factor compositions of the second factor solution) using item correlation analyses. These analyses yielded a corresponding set of provisional subscales which are being further psychometrically refined in terms of ongoing research. The subscales are mapped, in terms of their labels (A, B, C, F, G, and H), onto the similarly labelled qualitative categories presented earlier on.

A. Research as the gathering of information. This emerged clearly in the first factor analysis as F6, but not in the second in Table 2, owing to the deletion of five of the six items that essentially initially constituted the dimension. This "non-overlapping" dimension is nevertheless presented on conceptual grounds as one that may be psychometrically developed using alternative items. In the first factor analysis, and notwithstanding the fact that all but one of the items exhibited cross-loadings across other factors, there were six indicated items ($\alpha=.75$) that referred to research as something that is done to find information, a particular or primary method for collecting information, as collecting information to explain something, as collecting data for analytical purposes, and as the gathering of as much information as possible about something.

B. Research is about discovering the truth ($\alpha=.89$). The six items that constitute this dimension all exhibit some loadings on the other dimensions. Research here is seen essentially in terms of the quest for truth, in terms of fundamentally finding out, uncovering, or exhuming the truth, systematically hunting for the truth about something, and as something which is done to determine the truth or validity of something.

C. Research as an insightful process (α=.85). This dimension is constituted in terms of seven items that collectively describe research as providing a deeper insight and understanding of a particular topic, extending concepts, stimulating further interest or work in a particular area, creating new insights by summarizing new and previously existing knowledge, searching for more knowledge, or adding more knowledge to existing knowledge, and the idea that even new ideas germinate in a bed of existing knowledge.

F. Research viewed as re-search (α=.83). This dimension is constituted in terms of seven items supporting a view of research in terms of finding out about something that is already there, an investigation to find facts left out by previous researchers, comparing new results with previous results, discovering something that exists but that is hidden, challenging previous research, identifying information not considered in the past, and using research findings to reinterpret what is already known.

G. Research is seen as finding solutions to problems (α=.80). Five items constitute this dimension and they refer to research as finding solutions to problems, or to stated problems, as a tool for answering questions, collecting data to solve particular problems, and as the careful and thorough study of a problem.

H. Misconceptions about research (α=.85). This dimension is constituted in terms of eight items that collectively express a view that research is about gathering data that support preconceived ideas or that will back a particular argument, that correctly followed research procedures will always yield positive results, that when qualified people do research the results are always unbiased, that it is acceptable to modify research data if it does not look exactly right, that research becomes true after it is published, that if research is properly conducted then contradictory findings will never occur, and that there is generally only one way to interpret research findings.

Discussion

Given the attributes of the sample, it is quite remarkable that the inventory responses should exhibit such contrasting dimensions of variation. The majority of these students (92%) were actually engaged in postgraduate research, with some 40% engaged at Ph.D. level. Despite their comparatively elite status (compared with undergraduates) and, in all likelihood, exposure to "research methods" training, it is clear that the sample that they substantively constitute does not exhibit a uniform approach to conceptualizing research or the research process.

The present work lays the foundation for the systematic psychometric development of the SCoRI in the dimensions indicated, as well as in additional possible dimensions isolated in the analyses but not presented and in terms of further dimensions that may emerge in other sampling response contexts. Once this

psychometric development is accomplished, it is hoped that the SCoRI will facilitate the statistical modelling of students' conceptions of "research" at an individual and group level in descriptive, diagnostic, and inferential senses.

The strategic value of such modelling is obvious. It can be used, for example, to inform decisions of how postgraduate research methods courses might respond to variations in students' conceptions of "research" at an early stage. It may also serve to identify students whose conceptions of research are at variance (or dissonant) with those of their supervisors or the academic institution within which they intend to study. Such identification may, in turn, initiate appropriate supportive institutional responses directed towards students experiencing such difficulties. In this strategic sense there are clear linkages between the present study and the work on dissonance in postgraduate research reported by Wisker, Robinson, Trafford, Creighton, and Warnes (2003), as well as the phenomenographic work reported by Brew and Phillis (1997) and Brew (2000), in which investigations of researchers' conceptions of research have revealed (qualitative) dimensions of variation. Brew (2000), for example, described a "domino conception" (a focus on solving problems or answering questions) that resonates with the common factor dimension of "finding solutions to problems" in the present study. In a similar vein, there is some conceptual overlap between what Brew (2000) termed researchers' "layer conception" (discovering, uncovering, or creating underlying meanings) and the common factor labelled as "insightful process".

Work of this nature can also inform the design of research methodology courses, the fast tracking of undergraduate students with relatively sophisticated conceptions of research enquiry, supportive institutional responses to students who may possess less sophisticated conceptions, and responses to students who may exhibit dissonant patterns of research engagement.

Much promising future work is thus indicated. In terms of further developing the SCoRI, there is a need to sample a more diverse group of students, including undergraduates, in order to further test the construct validity and reliability of the dimensions provisionally isolated. In such a development process the interrelations between students' and researchers' conceptions of research and other proximal factors beg exploration. Such exploration could include, for example, the nature of the association (if any) between entry qualifications, research conceptions, and research completion, as well as the association between students' and supervisors' research conceptions and its relationship to thesis completion rates. A further question is whether there are differences between institution "types" (research-led versus teaching-led) and the research conception profiles of their respective students at a departmental or similar level of analysis. The question of how sensitive conceptions of research are to perceptions of the research environment (possibly within discipline contexts) also remains unanswered.

Other avenues of research parallel to the existing investigations, some of which have employed psychometric techniques, also suggest themselves. Such avenues include, for example, the question of whether factors such as "adjustment problems"

(Hockey, 1994), "mood" (Parsloe, 1993), and "level of procrastination" (Johnson, Green, & Kluever, 2000; Muszynski & Akamatsu, 1991) on the part of higher degree students are in fact reflections of particular underlying conceptions of research.

Finally, a focus on students' conceptions of research may in theory overcome some of the difficulties faced by earlier research that was unable to identify factors associated with successful completion rates by postgraduate students (Wright & Cochrane, 2000). In fact, the present research has the potential to make amenable to intervention areas currently regarded as "outside the influence" of an institution or supervisor (Latona & Browne, 2001). For example, if one characteristic of a successful research student is an ability to "think like a researcher", a knowledge of variation in students' conceptions of research may inform interventions intended to assist them in developing more expert views of research (Orton, 1999).

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Notes

1. Margaret Kiley (University of Canberra) and Gerald Mullins (University of Adelaide).
2. The South African students' responses were initially collected by means of a paper-based inventory and then entered onto the web-based site. There is the potential for some effect on the results if students respond differently to web-based and paper-based versions of the same inventory.
3. Students were encouraged to respond to the question "What is your specific area of research?" by providing their own categorization rather than limiting them to predetermined discipline areas. Unfortunately, most students' answers exceeded the character capturing capacity of the web site, thereby limiting interpretation of their responses. The figures refer to those disciplines that could be categorized within the first 40 characters of the responses supplied. A total $n>230$ was interpreted this way.

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Appendix. Emergent Conceptions of Research: verbatim responses

A. Research as Information Gathering

a. As an information gathering procedure

"… something you do when you want to find out some information"	[145]
"… finding out specific information … on subject unknown"	[139]
"… is collection of information … for a better result"	[142]
"… is … data collection"	[86]
"… research is valid collected information"	[81]
"… research has to do with the collection of data … to gather as much information as you can"	[89]
"… seeking information in a scientific fashion"	[132]
"… a method used to gather information"	[77]
"… a method of collecting information"	[91]
"… collection of information … which is carefully collated"	[142]

"… finding knowledge and facts" [134]
"… a scientific fact finding procedure … to get every detail … a scientific method of establishing facts" [114]
"… planned/scientific way of collecting information" [121]
"… method used to find information" [122]
"… systematic investigation to discover some facts" [133]

b. Adding to what we know
"… search more information in existing things … to find information" [75]
"… look for more information" [86]
"… acquire more knowledge about the subject … get more information" [128]
"… a search for more knowledge in a particular field … to accumulate more knowledge" [124]
"… supplement previous findings" [148]
"… to find the additional information that is vital to the subject matter … then added to the already found information" [84]
"… to search for more information to supplement the one we previously have" [89]
"… seeking for more information" [104]
"… finding new information to update the old one" [101]
"… a mechanism to … add more knowledge to … existing knowledge" [112]

c. Gathering information and analysing it
"… collect factual information … analysing" [93]
"… is about data collection … in order to make analysis" [154]
"… reflection on and analysis of gathered data … analysing and concluding on the gathered data" [129]

d. Gathering information, analysing it and presenting it
"… Information is gathered, analysed, interpreted and presenting it" [43]
"… involves collection of data … analysis of the data and publishing" [127]
"… collecting information … for the purpose of … explaining … to other people … and also for … describing such information to others" [91]
"… an undertaking aimed at … explaining an existing situation" [93]

B. Research is About Discovering the Truth

"… determine…the truth or validity …" [127]
"… uncovering of truth" [85]
"… finding new truths which might have been overlooked … exhuming the truth … quest for the truth" [129]
"… systematic hunting for facts or truths about a subject" [130]
"… it (truth) existed before, got hidden" [130]
"… a process through which the truth is being uncovered … to find out the truth" [111]

C. Research is About Insightful Exploration and Discovery

a. Exploration and discovery

"… examining a new subject with the objective to come to some sort of conclusion or discovery about it"	[3]
"… investigation of natural phenomena"	[2]
"… discover facts by proper scientific study"	[6]
"… discovering something … which we didn't know before"	[7]
"… discovery of something that existed before, but … got hidden from humanity"	[130]
"… an investigation about something that is known or unknown … to investigate something which you have never seen"	[138]

b. Create new insights

"… it is a process by which the understanding of a topic is furthered"	[16]
"… using or summarising existing knowledge and/or new knowledge by one's own work to create previously unknown insight"	[10]
"… providing a deeper insight and understanding of a particular topic"	[11]
"… extend present concepts…obtain a greater understanding"	[16]
"… improve…understanding"	[93]
"… to understand"	[146]
"… Research is about the attainment of knowledge"	[14]
"… find out knowledge"	[133]

D. Research is About Analytical and Systematic Enquiry

a. Process is directed and systematic

"… research is the process by which a question is formulated from the base of current knowledge … followed by a series of systematic enquiries … designed to answer that question. The word … implies direction and method as opposed to general observation …"	[1]
"… a scientific method and procedure"	[41]
"… begins by a process of reading the literature and becoming familiar with the field, and to assess where the field is at"	[6]
"… the processes that lead to the finding of explanations, causes, consequences or any relations in … phenomena"	[4]
"… application of systematic procedures"	[143]
"… explaining a particular phenomenon"	[22]
"… a systematic investigation"	[132]

b. Process is analytical: comparative, evaluative, diagnostic

"… research 'is about' analysis"	[127]
"… research 'is about' comparison"	[137]
"… research 'is about' evaluation"	[8]
"… research 'is about' diagnosis"	[94]

"… may not be able to evaluate a definitive answer to a specific question" [16]
"… challenge some research done before" [43]
"… compare the present results with the previous results" [137]
"… the pros and cons of the subject matter … reassessing it … reconciling the two" [84]
"… an undertaking from which the quality and the quantity of specific area is investigated" [87]
"… analysis of current … or old ways of doing things to determine their effectiveness" [127]
"… an undertaking from which the quality and the quantity of a specific area is investigated" [87]

c. Research is about hypothesis testing

"… hypothesis which needs to be tested on the information (gathered)" [135]
"… process of investigating and trying to prove whether a novel idea is correct" [5]
"… taking a course of critical investigation in answer to a particular question" [6]
"… formulates a hypothesis … then proceeds to investigate that hypothesis" [24]
"… conducting an experiment … hypothesis" [138]
"… experiment to test" [147]
"… research begins with a question" [149]
"… at first one needs an hypothesis then … prove validity of one's claim" [152]

d. Process is determined

"… follow the procedure of research sequentially" [132]
"… is a methodology … and a process" [131]
"… something that can be done based on … methods, results, discussion, conclusions …" [137]
"… means being concerned with logical alternatives … degrees of certainty in conclusions" [143]

E. Research is About Incompleteness

"… even the newest ideas germinate in a fertile bed of previous knowledge and ideas" [1]
"… research never finishes" [7]
"… the understanding of researched phenomena is the basis for new technologies" [4]
"… there is a cascade effect in answering or understanding one thing, many other areas present themselves for further investigation" [5]
"… there is no beginning or ending to research. There is always something new to study" [7]
"… stimulate further interest or work in the area" [16]
"… is a continuous process" [111]
"… research does not finish because someone can continue" [137]

F. Research as the Re-examination of Existing Knowledge

"… examine an old subject in a new and innovative way in order to come to some new discovery or conclusion" [3]
"… enquiry aiming to support/reject the known views about a particular phenomenon" [82]
"… confirm or clarify certain issues" [83]
"… find out…facts left out by early researchers … information not considered in past research" [133]
"… to go back and search what was searched before … revisiting something that has been previously visited … finding new truths which might have been overlooked in the past" [129]
"… searching again for information that could have been found" [107]
"… seek the additional information that might have been left out … in order to add the findings to the subject matter" [84]
"… finding out … information … find more information about something that is already there" [90]
"… to explore what was basically there" [98]

G. Research is Problem Based: Identify problems, study problems, solve problems

"… find out … problems and come up with possible solutions" [134]
"… to identify problems" [96]
"… the careful and thorough study of a problem" [26]
"… investigation of a particular problem" [45]
"… having seen a problem … find out cause … try to solve … to find solutions for stated problems" [136]
"… data are collected … to solve … particular problem" [135]
"… solving problems" [22]
"… find out … problems and come up with possible solutions" [134]
"… searching answers or findings of a problem" [46]

H. Misconceptions

"… research becomes true after it is published" [137]
"… research means gathering information on a specific topic. The findings are then used to analyse the data obtained" [153]
"… (good research) is … collection of resource materials which back your argument" [81]
"… qualitative research is very biased compared to quantitative research" [88]
"… problem … research strategy collect data … re-arrange data … compile and report … the above mentioned steps, if followed correctly … will yield positive results" [89]

Metaphor

a. Painting or seeing a picture

"Each new piece of knowledge adds to the emerging picture. You take your research findings and combine them with what is known" [6]

"Successful researchers can see the 'overall picture'" [14]

b. Making a puzzle

"The pieces of information logically fit together and the puzzle seems fairly complete. Other times the pieces don't fit and you need to study further and look for the pieces you need to complete the puzzle" [7]

c. As a tool

"… a planning tool" [44]

"… a tool used to answer questions" [25]

"… uses various … tools … to conduct … enquiry" [82]

"… a scientific investigation using tools" [94]

Source: SCoRI inventory responses, 2001.

Note. Emergent categories labelled A–H; associated sub-categories in italics. Numbers in brackets identify the source of the excerpt by case number.

The grouping of statements labelled "metaphor" does not constitute a category as such in terms of conceptual internal consistency, but is nevertheless presented under a single heading for the sake of completeness.