Teachers empower both the next generation of learners and educators. Communities value the intricate roles and responsibilities of teachers: many of whom go beyond the tangibles to cater to the learning needs of their students. The multidimensional and multifaceted relationship between teacher-education providers and teachers is a complex one. At one end of the spectrum sits the scholarship of teaching while at the enacted zone sits standards-based praxis. Teacher education and scholarship of teaching provides the avenue to demonstrate this interaction of knowledge, pedagogy, research and broadly, scholarship. Unfortunately, there is no strong consensus about the value of pedagogical preparation for teachers.

This monograph highlights the broad focus on how education draws its knowledge base from various disciplines; advancing that education itself can become a plethora for shared discourse and reflection. The chapters provide fresh demonstrated understanding into practice-enabled research directions and emphasise the position of research-based praxis in both schools and in institutions entrusted with teacher education. Importantly, the monograph demonstrates the two-way communication between the community and teacher educators about knowledge, experiences, values and diversity and to add value with the sole aim to enhance learning. It highlights education is a collective endeavour in that education and teacher education are subsets of the community, and deliberations in communities add important synergy to education's evolution and revolution. Thus, the process of inquiry is fundamental in education, and implies transcending traditional discipline-bound knowledge and processes. This monograph provides the challenge to educators that no single or specific discipline directs educational development and enrichment, nor does the latter exclude any.
Excellence in Scholarship
Excellence in Scholarship

Transcending Transdisciplinarity in Teacher Education

Edited by;

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SENSE PUBLISHERS
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# TABLE OF CONTENTS

Preface: On Scholarship: Scope, Opportunities and Challenges  
*Sivakumar Alagumalai*  
vii

The Contributors  
xvii

## Part 1: Contributions to Excellence in Scholarship (Primers/Keynotes)

1. Creating a Tradition of Research in Education: The Marjoribanks and Smolicz Achievement  
*Margaret J. Secombe*  
3

2. Effects of Socioeconomic Status, Class Size and Ability Grouping on Science Achievement: A Sociological Approach  
*John P. Keeves, Njora Hungi & I Gusti Ngurah Darmawan*  
19

3. Contributions of Family and School Capital to Student Achievement: An Examination of Marjoribanks’ Context Theory  
*Alan Russell*  
43

## Part 2: Multi-faith and Multi-values’ Contributions to Education

4. A Quantum Theory Look at the Challenges for Academic Research in Education  
*Lynn Arnold*  
57

5. Diversify Values or Value Diversity  
*Marietta Rossetto*  
69

6. Celebrating Multicultural Education and Promoting Linguistic and Cultural Diversity Through the Work of the Multicultural Education Committee  
*Lili Liang & Dorothy Missingham*  
77

7. Multifaith Chaplaincies in a Successful Pluralistic Society  
*Alan Larkin, Geoff Boyce & Abul Farooque*  
87

## Part 3: Equity and Inclusion in Education

8. Parents’ Perceptions of Their Children’s Social Skills and Social Behaviour  
*Carolyn Palmer*  
107
TABLE OF CONTENTS

9. Post-school Pathways in Australia: Participant Characteristics 123  
    *David D. Curtis*

10. An Historical Examination of a University’s Scheme to Find  
    a ‘Fair Way’ for All Students 139  
    *Stephanie Burley*

11. Towards a New and Inclusive Model of Senior Secondary Education 155  
    *Murray Thompson & Bob Holloway*

**Part 4: Value-adding Learning and Teaching**

12. Computer Simulations and Implications for Education and Society 165  
    *Simon Skrodal, Sivakumar Alagumalai, Mike Lawson & Paul Calder*

    Bullying in Australian Schools 177  
    *Jury Mohyla & Phillip T. Slee*

14. Promoting Science Education for All 187  
    *Francisco Ben & Sivakumar Alagumalai*

15. Social Change and Teacher’s Pay 197  
    *Steven Barrett*

**Part 5: Extending Scholarship’s Arena – Opportunities for All**

16. Asia In-country Experience: Impact on Teachers 215  
    *Doug Trevaskis*

17. Education and Culture: An Australian Coeducational Boarding School as  
    a Crucible for a Culturally Diverse Life as Seen Through the Eyes of the  
    Students Themselves. A Humanistic Sociological Study 235  
    *Mathew A. White*

18. Rural-Urban School Partnerships and Australia’s Sustainability 267  
    *John R. Halsey*

Epilogue: Implications for Teacher Education and Educators 279  
    *Sivakumar Alagumalai, Stephanie Burley, Margaret Scott & Wendy Zweck*
INTRODUCTION: EDUCATION, TEACHER EDUCATION AND SCHOLARSHIP

The Top of the Class Report (House of Representatives Standing Committee on Education and Vocational Training, 2007) and the Senate Report on Quality of School Education (Senate Employment, Workplace Relations and Education Committee, Department of the Senate, September 2007) have raised attention to education, schools, teachers and teaching. Furthermore, AITSL (2011) National Professional Standards for Teacher initiative, the Productivity Commission’s (2012) Report about ambiguities in linking performance-based pay to improve teacher quality, and OECD’s (2012) contention that there is ‘no overall relationship between average student performance and use of performance-based pay schemes’ raised questions as to the nature of teacher education and measurable quality indicators. Continued media scrutiny initiate polarised perceptions about teaching in general.

Schools of Education acknowledge and value the intricate roles and responsibilities of teachers. Teachers provide the lifeline (as symbolised by the tree-trunk in the image on the front cover) in society, empowering both the next generation of learners and educators. For example, the School of Education through the support of number of Schools/Departments within the Faculty and faculties within the University of Adelaide is committed to transmitting the exemplary practices of many teachers who go beyond the tangibles to cater for the learning needs of their students. Schools of Education have also put in place research-based praxis, and practice-enabled research directions for their program structure and course offerings.

The multidimensional and multifaceted relationship between teacher-education providers and teachers is a complex one. At one end of the spectrum sits the scholarship of teaching while at the enacted zone sits standards-based praxis. Importantly, student learning and achievement is pivotal to the success of this dynamic relationship and interactions. It is pertinent to note that “scholarship of teaching is not synonymous with excellent teaching” (Hutchings & Shulman, 1999, p.13). Fincher & Work (2006, p.293) argued that “teaching is the beginning of a continuum that leads to
S. ALAGUMALAI

scholarly teaching and potentially to scholarship related to teaching and students’ learning. All teachers should strive to become excellent teachers, but even then they may not be scholarly teachers.” Hence, the opportunity for the scholarship of teaching and associated research is positioned both with teacher-education providers and in formal school settings. The scholarship of teaching referred to here has a meta-dimension of relationship that includes questions related to student learning and achievement.

Good teaching implies the propensity to learn, and to go beyond knowledge transmission to knowledge transformation and extension (Boyer, 1991, p.11). Davis (2005, p.86) likewise argued that ‘teaching as educating’ was a deliberate sign-posting activity to prompt the learners toward fulfilment of their potentials; which demands a certain transdisciplinarity that involves ‘level-jumping’ across neurological, sociological, psychological, cultural and other phenomena that includes the technological aspects of ICT and simulations. Thus, effective teacher education programs and the scholarship of teaching need to transcend singular disciplinary pedagogy into transdisciplinary pedagogical practices (Palaiologou, 2010). It also means re-examining the knowledge system of teaching advanced by Kreber & Cranton (1997), through content reflection (instructional knowledge: what actions do I take in teaching?), premise reflection (curricular knowledge: why do I teach this way?), and process reflection (pedagogical knowledge: how can I foster student learning?). This can only be achieved by “making teaching community property” (Shulman, 1993, cited in Weston & McAlpine, 2001, p.90). Thus, teacher education includes the scholarship of teaching through the constant engagement with knowledge about learning and teaching, and about valuing teaching through facilitated dialogue within a community of practice. This community is becoming involved in a process of change through the use of ICT and computer-based simulation.

This monograph highlights the broad focus on how education draws its knowledge base from various disciplines, and advancing that education itself can become a plethora for shared discourse, inquiry and reflection. Importantly, the monograph demonstrates the two-way communication between the community of teacher educators about knowledge, experiences, values and diversity and to add value with the sole aim to enhance the learning of students in schools and universities.

EDUCATION: ENACTING THE FOUR PILLARS OF LEARNING

The Learning the Treasure Within Report (Delors, 1996a), ignited further reflections into education and its mediating factors. It presented to educators and teachers alike a holistic and integrated vision of education. It highlighted the paradigms of lifelong learning, and the four pillars of learning: ‘to be’, ‘to know’, ‘to do’, and ‘to live together’. The paradigms of lifelong learning were premised on societal changes, and also as collective social and political responsibilities.
The four pillars of learning are fundamental principles for reshaping education (Delors, 1996b):

- **Learning to know**: to provide the cognitive tools required to better comprehend the world and its complexities, and to provide an appropriate and adequate foundation for future learning.
- **Learning to do**: to provide the skills that would enable individuals to effectively participate in the global economy and society.
- **Learning to be**: to provide self-analytical and social skills to enable individuals to develop to their fullest potential psycho-socially, affectively as well as physically, for an all-round 'complete person.'
- **Learning to live together**: to expose individuals to the values implicit within human rights, democratic principles, intercultural understanding and respect and peace at all levels of society and human relationships to enable individuals and societies to live in peace and harmony.

The Report articulated the holistic and integrated nature of learning and education. It did not single out a specific discipline that educational development and enrichment was pivoted on. Although transdisciplinarity was not stated explicitly, the Report advanced the major factors that need to be in-phase and integrated (UNESCO, 2006). Thus, teacher education and the scholarship of teaching education demonstrate that knowledge creation is continuous and cumulative. As Hegarty (2000, p.451) demonstrated, scholarship engages the dynamic interaction of tacit and applied (explicit) knowledge. Figure 1 aptly captures the spiral knowledge creation and interaction of learning ... to know, to do, to be and to live together. Teacher education and scholarship of teaching provide the avenue to demonstrate this interaction of knowledge, pedagogy, research and broadly, scholarship.

Thus, teacher education (used interchangeably with the scholarship of teaching) activates inquiry and investigation into student learning. This coupling of reflection,
refinement and extension of innovation highlights the “mechanics through which the profession of teaching itself advances” (Shulman, 1999, p.14). The learning cycle advanced by Delors (1996a) through learning to know → learning to do → learning to be → learning to live together strengthens further the knowledge creation cycle advanced by Hegarty (2000). This implies transcending singular disciplinary pedagogy, and into transdisciplinarity (Palaiologou, 2010).

The constant evolution and refinement of the borders of education (and teacher education in particular) pose major challenges to those entrusted with the provision of quality and current teacher education programs – both pre-service and in-service. Kenneth Eble (cited in Boyer, 1991, p.12) challenged “the urgent need to broaden visions about education, and to re-examine current teaching practices in the hope of re-fashioning (higher) education.”

Figure 2 makes explicit the interconnectedness between teaching and the scholarship of teaching. Importantly, the concept of integration (Fincher & Work, 2006, p.294) emphasises the “connections within and across disciplines, placing the discipline in a broader context.” Are teacher educators ready for this broad and noble challenge, to look beyond their own boundaries of comfort and embrace ‘other’ knowledge forms and practices? Can teacher education be embedded within transdisciplinarity (Palaiologou, 2010)?

![Teaching/Scholarship Pyramid](image)

**Figure 2. The pyramid of teaching and scholarship (Fincher & Work, 2006, p.294).**

**CHANGING NATURE OF EDUCATION AND RESEARCH EVIDENCE**

Popkewitz & Fendler (1999) examined issues related to critical thinking traditions within education. They concluded that discursive practices and performances of
ON SCHOLARSHIP

schooling are significant forces that continue to change and shape the nature of education theory and education itself. However, the changing nature of education goes beyond the practices and performances in schools; knowledge and associated processes evolve constantly, and those entrusted with advancing education are obliged to engage in the scholarship of teaching. Fundamental and accepted basic pieces of knowledge continue to be replaced with evidence-backed schemas and structures. Moreover, “the connectedness that comes through developing the larger frameworks so that knowledge can be transferred and used across different contexts and to address unfamiliar problems is one of the defining features of the 21st century competences” (OECD, 2010a, p.17). Unfortunately, the transfer of learning and understanding pose major challenges. Are these concerns addressed in teacher education through their ‘inquiry and investigation-type courses’?

Understanding the connectedness of knowledge and to transfer and apply them to better equip diverse learners is an important professional attribute required of teachers (OECD, 2010b). Transdisciplinarity creates an approach that tackles the complexity of an evolving and constantly changing field such as education, as it challenges knowledge insularity and fragmentation (Palaiologou, 2010, p.278). The nexus between tacit and explicit knowledge must be elaborated in teacher education programs, as it makes evident the dynamics of interaction in education. Thus, it is imperative that education students and teachers involved in professional development take into cognisance that knowledge transfer through transdisciplinarity provides the substrate and methodology for proactively sharing knowledge (Palaiologou, 2010). Hence, knowledge forms need to be respected and integrated meaningfully to enhance appropriate discourse between and within specialist groups entrusted with the education of teachers.

Villeges & Lucas (2002) provide evidence of an evolving teacher education curriculum. In highlighting the need for understanding diversity in education, they argue that a robust teacher education program needs to respond to evolving social and cultural contexts and needs. Robertson (1994, p.50) noted “nowhere is the political nature of change more apparent than in the confused and even muted debate over the restructuring of teacher education in Australia.” Thus, an effective teacher education program that demonstrates the scholarship of teaching needs to provide convincing evidence for course and module inclusion. Loughran (2007, p.15) advanced “there is a need to demonstrate scholarship by making clear that personal theories are challenged in ways that help the researcher (and the audience) see beyond the personal alone. Scholarship might then be clear in how the researcher demonstrates a concern for rigorous data gathering and analysis, transparency in methods, and an ability to develop knowledge that extends beyond the individual and into the teacher education community more generally.” He emphasised that good research around the scholarship of teaching and teacher education must be supported though rigorous data gathering and analyses. Importantly, data sources must be stable, empirical and methods adopted that are transparent (Loughran, 2007). Hence, for teaching to be
community-owned the scholar (educator/teacher) is accountable through making the processes of inquiry and associated methods explicit.

The OECD’s (2009) new Teaching and Learning International Survey (TALIS) is one study that seeks to provide a snapshot of the status of teacher education, and also the context of teaching. TALIS has been designed to provide data and analyses on the conditions needed for effective teaching and learning in schools. As the first international survey with this focus, it seeks to fill important information gaps that have been identified at the national and international levels. Walberg (2010) was quick to highlight the shift from examining the overall effects of teachers on student achievement to an analysis of why such effects occur.

TALIS (OECD, 2009) and arguments advanced by Walberg (2010) are drawn from Anderson & Postlethwaite’s (2007, p.2) proposal that “when introducing new education programs it is not easy to assess whether they have had an effect on student learning. ... Education programs cannot be said to be effective if there are no measurable improvements in student learning over time. If there are measurable changes in student learning over time, but the magnitude of the changes is not different from changes that occur in non-program students, then the program cannot be said to be effective. ... Both small- and large-scale studies are needed within any one evaluation project.” These ongoing debates highlight further Mason’s (2008) complexity of education and its implications for educational research and research into teacher education.

The significant impacts of the works on teacher education by Crowe (2010), Darling-Hammond (2010), Ingvarson et al., (2006), Jensen (2010), McKinsey Report (2007), Mourshed et al., (2010), Trani & Irvine (2010), and Weldon et al., (2011) are acknowledged here. They confirm further the evolving nature of teacher education (and scholarship of teaching), and the importance of rigorous research to inform and direct policies on what constitutes efficient education programs. Thus, Andreas Schleicher’s statement (OECD 2010/2011), “without data, you are just another person with an opinion,” has important relevance to what is offered by Schools of Education, and eventually for the community.

Opportunities and Challenges

The above sections highlight a number of key priorities in achieving the highest level of scholarship in education, and in teacher education. It starts with first understanding the nature of education, and appreciating the complexity embedded within an evolving ‘field’. It also stresses on the need for more rigorous, objective and transparent research methods (and techniques) to help shape the courses and modules within education programs. Importantly, education is constantly shaped by both within and between perceptually-constructed forces, and external socio-political forces. The impact of the ‘within perceptually-constructed forces’ is evidenced through Kreber & Cranton’s observation (2000, p.492), “despite recent endeavours to broaden the conceptualisation of scholarship, the notion of the scholarship of teaching has remained an ill-defined concept.”
This is not surprising, as Francois Taddai (cited in Nowotny, 2008) puts it: “No discipline knows more than all disciplines”. If collective problem solving is the aim, then the means must provide for an integration of perspectives in the identification, formulation and resolution of what has to become a shared problem. Education is thus a collective endeavour; no one piece of evidence or paradigm is superior to the other. However, being open to the various paradigms (and at times perceptions and data-free views), one should be reminded of Robertson’s (1994, p.57) caution that “the structure and nature of teacher education, emerges from an agenda seeking to establish a new accumulation regime with tightened ideological and structural controls. Neither the teacher educator nor the intern will be valued for their pedagogical insights and their capacity to develop students’ critical thinking and intellectual and social autonomy. Rather teacher educators will be valued for their capacity to deliver, efficiently and cheaply, the essential necessary skills for the labour market and the appropriate attitudes to facilitate social integration in what will be increasingly experienced as hard and troubled times.”

Thus, teacher education and education studies programs must transcend the structure of a single academic discipline and include the involvement of all disciplines (and all academic knowledge) with the sole aim to improve student learning and achievement (Palaiologou, 2010, p.278). In advancing the notion of an evolving field, and the need for being receptive to transdisciplinarity, we must keep in focus the primacy and importance of students’ learning and achievement (Tochon, 2010).

Gardner & Shulman (2005, p.18) warned “it took centuries for professions to achieve their central role in a complex society; it would take far less time to undermine their legitimacy.” “Perhaps most dramatically, potent market forces, untempered by forces of equivalent power, have made it increasingly difficult to delineate just how professionals today differ from those nonprofessionals who also have power and resources in the society (Gardner & Shulman, 2005, p.14). Educators, and teacher educators in particular need to take into cognisance the central position of the teaching profession, its role in knowledge creation and extension, and empowering learners, local communities and the broader society. Zeichner (1999, p.13), aptly concluded that it is our collective responsibility to “take more seriously the new scholarship in teacher education and use it to help us make our programs better.”

This monograph draws on this multidimensional and multifaceted conception of education, teacher education and the scholarship of teaching, and addresses the challenges and opportunities indicated in the above sections.

Structure of this Monograph

Four broad dimensions (Parts 2-5) highlight the breadth of the education field, and primed succinctly by authors in Part 1(Contributions to Excellence in Scholarship). Articles in Part 1 provide insights into the interactions that happen at the micro-(student), meso-(family, class, teacher) and macro-levels (school, community/society, teacher-education provider). Chapter 1 provides the base for research-based praxis,
and practice-enabled research and emphasises the need for Schools of Education to engage in the process of inquiry. The chapter highlights further the need to engage in collaborative research, and for the outcomes of research to be add value to education programs and to the community. Chapters 2 and 3 extend the works of scholars and educators in Chapter 1, and position the need to examine the influences of family and school on student’s learning. Chapters 2 and 3 draw on methods utilised in large-scale international studies (PISA, TIMSS, ESS and TALIS) and emphasise that excellence in scholarship transcends journal publications. These articles demonstrate the intricate interactions between educators and communities and with experiences (and knowledge) disseminated through modules in selected teacher education programs.

The articles in Parts 2-5 extend Shulman’s (1993) argument for ‘making teaching community property’; these chapters link the community into education processes, and offer avenues for reflection and in extending praxis. Acknowledging, understanding and respecting diversity is crucial for education. Chapters in Parts 2 and 3 challenge readers on issues related to values, diversity, inclusivity, equity and having a fair-go. These chapters address a variety of pathways to achieving successful learning outcomes, and with students coming from various backgrounds. These chapters highlight the democratic and inclusive processes engaged by societies (and education providers) in presenting ALL learners with opportunities for learning.

Chapters in Parts 4 and 5 provide evidence of initiatives to engage learners (formal schooling), education students, and teachers undertaking professional development to provide an understanding of what best supports learning (and teaching). These chapters provide information about ongoing inquiry processes, and with feedback loops into both education programs and importantly into the community. Chapters in Part 5 extend the traditional boundaries of schools and providers of teacher education into initiatives in rural areas and into learning environments beyond the ‘mortar walls of teaching’.

The carefully selected chapters of this monograph highlight the sustained need for educators, education and education programs to engage with community deliberations, and beyond the classical subject and discipline areas. The various chapters provide insights into institutional inquiry processes and in making available to education students and practising teachers, methods and plausible findings. Specifically, the chapters highlight the need to engage and interact widely both within specialist disciplines and between communities and to advance the scholarship of teaching (and learning) through evidence-based practices and not detracted by naïve opinions and misconceptions.

The editors had been mindful of the broad themes identified for this monograph. The diverse writing styles and formats that author(s) selected are respected, and this monograph highlights the complexity in education and educational endeavours. Importantly, this monograph provides the catalyst for further dialogues and discourses within Schools of Education, and the broader education and teaching profession. Education and teacher education involve subsets of the community, and deliberations within communities add important synergy to education’s evolution and revolution.
ON SCHOLARSHIP

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PART 1

CONTRIBUTIONS TO EXCELLENCE IN SCHOLARSHIP (PRIMERS/KEYNOTES)
CHAPTER 1

CREATING A TRADITION OF RESEARCH IN EDUCATION

The Marjoribanks and Smolicz Achievement

INTRODUCTION

It is a great honour to be asked to review the contributions made by Professor Kevin Marjoribanks and Professor J J (George) Smolicz to the Department (now School) of Education at the University of Adelaide over more than thirty years. I only hope that I can do justice to the responsibility laid on me. Given that I was their colleague over that period, I intend to adopt a less formal tone than might be expected and refer to them by their first or Christian names, instead of their formal academic titles. I tutored to the Graduate Diploma in Education lectures of both Kevin and George; I collaborated in research with George; and worked closely with Kevin in the administration of the department, especially in the last years of his headship, after he completed his term as Vice-Chancellor of the University. With both I shared the supervision of research students. Given all these circumstances, I consider it appropriate to adopt what may be called a personal or lived history approach to the topic, but with a sociological emphasis in interpretation and analysis.

OBJECTIVE MEASURES OF RESEARCH

Let us begin by trying to satisfy those who believe that objective outcomes are the only proper measure of educational achievement – in this case, the contributions that Kevin and George made to research in education. Tables 1 and 2 below present data from the University of Adelaide’s Department of Education in relation to two indicators which are often taken as measures of research excellence: the number of students completing research degrees and the number of research books and articles published.

Table 1 sets out the research degree completions in Education since the establishment of a university department in the discipline. (Its beginnings will be considered a little later.) The 45 years of its existence have been divided into
three fifteen year periods. Not only is it convenient to have three equal periods to
compare, but more importantly, the divisions can be seen to reflect important stages
in the Department’s history. Each one has been named according to my judgement
of its key significance. The total column shows that there was a more than three-
fold increase in research completions from the first to the second period, with the
great majority of completions being at the Master of Education level in both periods.
The two Ph Ds in the first period were awarded to staff in the Department. The
momentum of completions was sustained, and even exceeded, in the third period,
when Ph D completions came to predominate.

Table 1. Research degree completions 1960–2005, Department (now School) of Education,
University of Adelaide

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<td></td>
<td></td>
<td>1 P, 1 R, 6 SL, 2 L, 2 ST, 2 T =14</td>
</tr>
<tr>
<td>1991–2005 The Time of Increasing Canberra Control</td>
<td>29</td>
<td>35</td>
<td>1</td>
<td>65</td>
<td>half of Ph Ds &amp; Masters</td>
<td>1992 1 P, 1 R, 12 SL, 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L; 2 T = 24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1998 2 P, 1 R, 3SL, 1 L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>=7#</td>
</tr>
</tbody>
</table>

*P = Professor  R = Reader (= A/ Professor)  SL = Senior Lecturer
L = Lecturer (Level B)  ST = Senior Tutor (with tenure)
T = Tutor (maximum appointment 6 years)
#Compare 2006 3 SL, 4L =7


Table 2 attempts to show, in an illustrative, not comprehensive way, the research publications record of Education Department staff from the University of Adelaide
CREATING A TRADITION OF RESEARCH IN EDUCATION

for three selected years. To the best of my knowledge, the publicly available data on University of Adelaide’s staff research publications begins only in 1987, when Kevin as Vice-Chancellor initiated the annual University of Adelaide Research Report.

Table 2. Research publications of Department of Education staff, University of Adelaide (Selected Years 1974–2005)†

<table>
<thead>
<tr>
<th>Year</th>
<th>Professor Marjoribanks’ Publications</th>
<th>Dr J J Smolicz’s Publications as Reader</th>
<th>Total KM &amp; JJS’s publications</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Year &amp; Department</th>
<th>Total staff</th>
<th>Staff with publications</th>
<th>Total research items</th>
<th>KM &amp; JJS’s publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987 Ed Dept</td>
<td>14</td>
<td>10</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>V-C</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>11</td>
<td>23</td>
<td>11 (48%)</td>
</tr>
<tr>
<td>1992 Ed Dept</td>
<td>24</td>
<td>5</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>V-C</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>6</td>
<td>20</td>
<td>16 (80%)</td>
</tr>
<tr>
<td>1998 Ed Dept</td>
<td>7</td>
<td>4</td>
<td>19</td>
<td>16 (84%)</td>
</tr>
</tbody>
</table>


After his tenure as Vice-Chancellor, the Commonwealth Government’s Department of Education and Training began to collect data on research publications of all university staff for its annual research audit, which determined research funding to the universities for the subsequent year. The only way to access data on research publications prior to 1987 is via the Curriculum Vitae and publications’ list of individual staff members. As a result it is not possible to compare the number of research publications from the first period with those from the second and third.

A glance at the totals in Column 4 reveals a reasonable degree of consistency in the overall number of research items published in each of the three selected
years –23 in 1987, 20 in 1992 and 19 in 1998, although it is worth noting the slow decline. What varies noticeably is the number of staff contributing to research publications in these years. In 1987, when Departmental staff numbered 14 and Kevin was continuing to do educational research in his first year as Vice-Chancellor, a total of eleven staff contributed publications. In 1992, following the merger with the South Australian College of Advanced Education (SACAE), when staff numbers reached (briefly) an all-time high of 24, there were only five Education staff, plus Kevin as Vice-Chancellor, who had research published. Perhaps that says something about the many hours of consultation in which the combined staff were engaged over 1991, in order to have a new Graduate Diploma in Education operating in 1992. By 1998, the number of staff making research contributions had fallen to four, at a time when the total staff numbers had been reduced dramatically to seven.

The question to be put to these data is how far Kevin and George contributed to the Department’s research degree completions and research publications’ record. In the case of research degree completions (Table 1), we can see that in the first period, George in the sociology area was involved in the supervision of a quarter of the Masters theses. In the second period, after Kevin joined the Department as a Professor in the sociology area, a third of the Ph Ds and a quarter of the Masters theses were in this field. The notable aspect of research completions in the second period, revealed in the primary data giving thesis topics and supervisors, was the way in which they were spread across a range of educational disciplines. This was sustainable when staff numbers were as high as 19, and even when they were slowly reduced, through retirement, moves and the non-replacement of tutors, to 14. English, Maths and Science Curricula areas and Theory/Philosophy of Education were all represented, although the three most popular research areas were History of Education, Educational Psychology, and Sociology of Education.

The main feature of the third period was an increase in the proportion of completions in the sociology area. To a large extent, this can be seen to reflect staff losses. The sudden increase in staff numbers to 24, after the merger with the Kintore Avenue SACAE in 1991, had little impact on research completions. Research had not been part of the expected role of SACAE staff, and with two or three notable exceptions, those who joined the University of Adelaide’s Department of Education were not interested in supervising research students or in publishing research papers. Then within two years there began a dramatic decline in staff numbers through retirement, as well as voluntary and forced redundancies. By 1998, only seven staff remained; this number included Kevin who had returned as Head after his period as Vice-Chancellor. The Department was left with no-one in theory or philosophy, only one historian and one psychologist, but three staff in the area of sociology. In these circumstances it was inevitable that research completions in sociology increased.

The data on research publications (Table 2) gives evidence of a similar pattern over the years from 1987 to 1998. Although we have no data from the earliest period, it was generally known that the Foundation Professor of Education, Laurie Neal, was not a researcher. He published a few scholarly articles and opinion pieces, in
CREATING A TRADITION OF RESEARCH IN EDUCATION

line with the expectations of academics in the Theory of Education area. In 1987, Kevin and George’s contribution to the Department’s research record was 48%. By 1992 it had risen to 80% and was even higher in 1998. The preoccupation of many staff with the merger and the loss of key researchers in the exodus of 1994–7 help to explain these figures. Nevertheless, the consistency of Kevin and George’s research publications over the years is remarkable: 11 in 1987, 16 in 1992 and 16 in 1998. The data for 1974 (the first year in which they were together in the Department), taken from their own publication lists (Marjoribanks, 2005; Smolicz, 2005), are also revealing in this regard – a total of 15 new items between them.

From the figures in these two tables we can, I think, conclude that Kevin and George’s individual contributions to research in each period went well beyond what could be reasonably expected of one person among 12–13 tenured staff in the second period, or even one among the seven tenured staff in the latter half of the third period. The dominance of their contribution was particularly evident in the third period and on the measure of research publications. These can be regarded as the main findings to be gleaned from the objective indicators.

A PERSPECTIVE FROM LIVED HISTORY

The figures in the tables, however, provide only the bare bones of Kevin and George’s achievement. An appreciation of the historical context, given from the personal perspective of a participant, can I believe help to flesh out a deeper understanding of the significance of what they did, and perhaps even add some mind and soul to it. I shall concentrate on two aspects: my personal understanding of the situation preceding and during the first period, before Kevin and George came together in the Department and my later experience of the Department in the second period.

I was a diploma in education student in the first two years following the formal establishment of the Department of Education at the University of Adelaide and a Master of Education student for another two years in 1973 and 1974. For the following 30 years, I was a full time member of staff; I have thus known personally the changes, the development and the reverses that have occurred over the 45 years of the Department/School’s existence. Table 3 provides an overview of the main changes in education programs over this time.

When I began as a student enrolled concurrently at the University of Adelaide and the Adelaide Teachers College in 1958, there were two University of Adelaide awards in education. The Diploma in Education was designed originally for students intending to teach in high schools or independent colleges, after graduating in arts or science (University of Adelaide, 1913; 1958). The award of Associate of the University of Adelaide (AUA), mainly taken out by those preparing to be teachers in primary or infant schools (as they were then called), involved six subjects in arts and education. Both awards were built around the second year arts subject called Education, which from the time of its establishment, had encompassed the history of education, as one strand, and the theory or philosophy of education,
as the other. According to Harmstorf’s research, on the history of education as a field of study at the University of Adelaide, the Diploma in Education with its key subject, Education, was incorporated into the statutes of the Faculty of Arts in 1911. The person responsible for this move was William Mitchell, Professor of Mental and Moral Philosophy, who regarded both psychology and education as subjects falling within the scope of his discipline area (Department of Education, University of Adelaide, 1994, p. 8). Both the Diploma and the subject Education were offered for the next 50 years without interruption, or very much change,

Table 3. Main Education awards at the University of Adelaide, 1958–2004 (2009*)

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>Diploma in Education</td>
<td>Had pre-primary, primary &amp; secondary options (regulations introduced 1911 for secondary only) Taught concurrently with first degree, but awarded only to graduates, and, in practice, after at least one year’s teaching experience</td>
</tr>
<tr>
<td>1958</td>
<td>Associate of the University of Adelaide (A.U.A.)</td>
<td>Completion of 6 courses in Arts &amp; Education</td>
</tr>
<tr>
<td>1960</td>
<td>Ph D</td>
<td>University wide award, introduced 1952, offered in education for first time when Department established</td>
</tr>
<tr>
<td>1962</td>
<td>new Diploma in Education</td>
<td>Postgraduate entry; for intending secondary teachers only</td>
</tr>
<tr>
<td>1962</td>
<td>Master of Education</td>
<td>1 year coursework + 1 year thesis Entry - degree + Dip Ed Changed in mid ‘90s to 1 semester coursework + 2 semesters of thesis, with entry = 2A Hons</td>
</tr>
<tr>
<td>1990</td>
<td>Master of Educational Studies</td>
<td>Coursework Masters program (3 semesters, later 2 semesters, with possibility of Research Project)</td>
</tr>
<tr>
<td>1992</td>
<td>new Graduate Diploma in Education</td>
<td>Result of merger between SACAE program in Schulz Bldg and that of Uni of Adelaide in Napier Bldg</td>
</tr>
<tr>
<td>1992</td>
<td>Master of Educational Administration</td>
<td>Coursework Masters program (3 semesters) – result of merger; available by distance ed; ceased 1997</td>
</tr>
<tr>
<td>1999</td>
<td>Doctor of Education</td>
<td>Professional research doctorate - initially 1 year of coursework + 2 years of research portfolio; modified to 4 years of research portfolio in 2004</td>
</tr>
<tr>
<td>2004</td>
<td>Bachelor of Teaching</td>
<td>Education courses taken concurrently with studies for first degree; both degrees completed in 4 years</td>
</tr>
</tbody>
</table>

*20 January 2009: Teachers Registration Board of South Australia - “the initial pre-service teacher education qualifications of a Graduate Diploma in Education, a Bachelor of Music Education, and a Bachelor of Teaching Double Degree from the University of Adelaide, meets the Board’s minimum qualification requirement for the purpose of teacher registration in South Australia.”

apart from the introduction of primary and pre-primary options for the Diploma in the 1930s.

Through all this time, however, there was no Department of Education at the University of Adelaide and no University staff appointed to teach full time in Education. The University Calendars over these years list two to four names for Education, under the heading Part-Time, since all were employed full-time at the Adelaide Teachers College (ATC), a separate institution, dedicated solely to the training of teachers for schools. In 1958–59, all the Diploma in Education subjects which I studied were taught by staff of the ATC or other government officers.

Since there was no staff in education at the only university in the state, there was no place where research was being carried out, and no opportunity for higher degree study and educational research in South Australia. In fairness, it needs to be remembered that the Ph D, as a university–wide research degree, only became available in 1952 (University of Adelaide, 1952, p. 492). Before that anyone wanting to do a Ph D in any subject area was forced to go abroad, usually to the U.K. or the U.S.A. The ATC staff had no requirement to be involved in research; their total pre-occupation was the pre-service preparation of teachers and their teaching and administrative loads precluded any time for research. Moreover, the whole orientation of the College was against such purely academic pursuits as research in education. The only person on the College staff with a Ph D was the Principal, Dr Harry Penny, who was awarded the degree from the London Institute of Education on the basis of a thesis arguing that measurement was totally inappropriate in educational research (Keeves, 2006).

Then in 1959 came a dramatic new development. I can still remember the ripple of expectation and excitement which passed through the College staff and student body, when it became known that the University had appointed a Professor of Education. By 1961 there were two additional lecturers to form the nucleus of a University Department of Education (University of Adelaide, 1961, p. 56). So it was in 1961, when I was doing mainly education subjects in my final year, that I had University, not College, staff teaching in two Diploma in Education subjects. Professor Neal was the lecturer for the Theory strand of the subject, Education, Ernest Roe for the History strand, as well as the subject Educational Psychology II, and I had Derek Toomey as Tutor for Education.

The hopes and expectations centred on Laurie Neal when he was appointed Professor of Education and Head of Department at Adelaide, however, were short-lived. Within two years he had made it clear that he would not continue co-operation with ATC. He favoured a one year full-time, end-on Diploma in Education for graduate students intending to be secondary school teachers. The new Diploma in Education, introduced in 1962, was based on what were regarded as the four theoretical pillars of education - history, theory, psychology and sociology, together with teaching practice and curriculum and methodology subjects (University of Adelaide, 1962, p. 564). The four theoretical subjects were taught exclusively by University staff. By 1965, when George joined the Department, staff numbers had expanded to eight to cover this teaching load (University of Adelaide, 1965, p. 70).
After more than fifty years of co-operation in the preparation of teachers and the provision of education awards in South Australia, the College and the University separated. The College was forced to develop its own pre-primary, primary and secondary teaching qualifications, becoming before long a College of Advanced Education (CAE). For the next thirty years, the two were rivals in the provision of secondary teacher training; reconciliation came finally with the merger in 1991 of the Kintore Avenue education staff of the South Australian College of Advanced Education with the University of Adelaide’s Department of Education.

Nevertheless, the establishment of a Department of Education at the University brought one important and positive outcome – the opportunity for undertaking research degrees, both Ph D and the newly introduced Master of Education. Half coursework, half research, the M Ed was regarded as a research degree throughout the first two periods. (In the 1990s when the Commonwealth government imposed regulations requiring all research degrees to be at least two thirds research, changes were made to the degree to conform to these requirements.)

It was as a Masters research student that I returned to the Department in 1973, after eleven years of teaching experience. Professor Neal was still Head of a University Department which had increased in staff numbers to fourteen, with a further rise to nineteen in 1974 (University of Adelaide, 1974, p. 89–90). I found three or four students, employed as tutors in the Department, doing Ph D research, mainly in psychology or in sociology with George. There were two other fulltime Masters students (neither of whom went on to the thesis stage), but in the part-time evening Masters classes, there were groups of ten to twelve teachers interested in extending their study of education. Many of these went on to successfully complete Masters theses. The M Ed provided an excellent way into further research studies in education, since its pre-requisites did not include an honours degree, a qualification which few teachers at that time had had the opportunity to gain. Here, it seemed, was a nucleus for research, with potential for development in succeeding years.

By 1974 then, at the end of the first period, there were signs of research activity developing. But it is in the context of nothing, no research at all, prior to 1960, and only very modest beginnings in research degrees and publications over the following fifteen years, that Kevin and George’s research achievements need to be understood.

I also wish to comment, from a personal point of view, on the second fifteen year period, which began just after Kevin and I joined the Department. Tables 1 and 2 show that this was a period when research began to flourish, with a greater number of staff participating in research supervision and publications than in any other period. What the figures themselves do not explain was the very different research-oriented ethos which began to pervade the Department. The change came with the new policy of academic democracy, whereby the Chairs of Departments, Deans of Faculties and a central administrative committee for the whole university were elected, not appointed, as had previously been the case. It represented a shift in power away from senior members of staff, many of whom held dual positions as academic professors and appointed heads of departments. In some cases they had proved to be stern
and authoritarian taskmasters. The shift in power away from senior professors to younger staff and students was part of a world-wide trend, sparked by the riots of French students in the late 1960s and spreading through much of Western Europe and English speaking countries.

George was the first elected Chair of the Department and Kevin the second. The result was that their high level of commitment to research became accepted by others in the Department. Teaching in Diploma of Education and especially Masters subjects directly reflected staff research interests and publications. This led naturally to Masters students choosing supervisors whose interests and research approaches overlapped with theirs. The small but reasonable amount of research funding available was distributed in an egalitarian fashion, so that most staff could access what they needed. In these ways, but particularly through their example, Kevin and George not only made research a priority in the department, but set the pace in achieving research outcomes that were three times greater than in the first period.

A REVIEW OF KEVIN & GEORGE’S RESEARCH CONTRIBUTIONS

At this point it is appropriate to attempt a review of Kevin and George’s research achievements. In terms of numbers of publications, Kevin had seven books, one edited book and over 260 articles in leading international journals in the U.S., Canada and Australia. For a period early in his career, he was the honorary research director for the International Baccalaureate Association. He was also the foundation editor of the *Oxford Review of Education* and later served as editor of the *Australian Journal of Education* (Marjoribanks, 2005). In a nutshell, this represented his life’s commitment to research in education.

In George’s case, he had three books in English, two of which were translated into Polish, and one edited book in English. There were over 230 book chapters and articles published mainly in the U.K., Europe and Asia; over thirty of these were translated into Polish, and some into French, German, Italian and Spanish. Many of these publications were prepared in their first form as conference papers for one of the frequent presentations he made at international conferences around the world. In addition, he contributed significantly to three key government reports on multiculturalism, languages and education, as well as two other government funded projects on adult ESL provision and the recognition of overseas qualifications (Smolicz, 2005).

Such numbers in a nutshell say little about the content or methodological approach of Kevin and George’s research. I will try to provide an outline, largely from the point of view of having tutored to the lecture courses of both over many years. Some clue to what their research was about is given at the top of Table 2, where there is a summary of their publications for 1974, the first year they were together in the department. It provides an indication of the directions their research took over the following thirty years.
Kevin’s research was already clearly focussed on quantitative studies of environmental factors influencing children’s learning. The book which he edited that year, *Environments for Learning*, considered both school and family factors. In the following years, he pursued large scale investigations of family learning environments, using multiple regression analysis. The results were published in two books, *Families and their Learning Environments* (Marjoribanks, 1979) and *Ethnic Families and Children’s Achievements* (Marjoribanks, 1980).

The work which in my view represents the culmination of Kevin’s research contribution was the book, *Family and School Capital: Towards a Context Theory of Students’ School Outcomes* (Marjoribanks, 2002). Here he elaborated and extended the theory of social, cultural and educational capital, derived from Bourdieu, and applied it to the study of both school and family contexts. Most researchers choose to focus on one or other of these contexts; few have tried to bring together the two contexts which are an integral part of every child’s life and learning. It was part of Kevin’s originality as a researcher that he studied the two side by side to give a more complete and holistic understanding of a child’s learning situation.

The second original element in this book was the research method adopted. Kevin’s international reputation was built on his expertise as a quantitative researcher, using mediation/moderation models and multiple regression techniques. Yet he did not consider that this “political arithmetic” (Marjoribanks, 2002, p. 21), was the only way of doing research or understanding social and educational reality. The method in this book matched political arithmetic investigations with interpretative studies which sought to understand individuals’ experiences and perceptions of meaning. He analysed the autobiographies of a number of famous authors, looking at their memories of early childhood learning and their experiences at school. He also used personal reflections of post-graduate students and unemployed young people about their learning in school and family contexts in the same interpretative way. In this way the population-wide propositions validated in the statistical analyses were illuminated by insights into what these meant in the lives of individuals.

Kevin’s research interest in school learning contexts had important practical applications in South Australian schools. Not long after his arrival in Adelaide, he became involved as a researcher with the Ten Schools Project, investigating the effectiveness of the earliest attempts to introduce multiculturalism not only into teaching and curriculum, but also into the whole school learning context. Later, as Vice-Chancellor, he established the Fairway Scheme, based on identifying South Australian schools which had what he referred to in his research as low educational capital. The scheme has given many students from schools in rural or low socio-economic areas an otherwise unreachable chance of studying at the University of Adelaide.

It was Kevin’s conviction that school was a learning context to be investigated and changed which caught the imagination of graduate diploma in education students when he was lecturing about his research. He challenged them with the idea that they
as teachers could make a difference. It only needed one teacher, or one member of a family, to help, encourage and provide inspiration to change the motivation and learning aspirations of a child. Particularly in the case of children who had low educational capital at home, the possibility of encountering at school just one teacher who believed in them was very important for their future learning achievement. The egalitarian aim of schools giving every child the best possible context for learning lay at the heart of Kevin’s research.

The summary of George’s 1974 publications at the top of Table 2 gives an indication of his more diverse output. His first two publications had been in Chemistry and that provided a base for work in the History and Sociology of Science and its implications for science teaching, an area in which he had three publications in 1974. There were also two articles on humanistic sociology and one of his earliest papers on multiculturalism.

George’s adaptation of the theory and methods of humanistic sociology was the direct result of a 1972 period of study leave spent in Poland, where he met leading Polish sociologists working in the humanistic sociological tradition of Florian Znaniecki. The basic assumption of humanistic sociology was that individuals were active agents able to make decisions, modify circumstances and change events within the constraints of their social and cultural contexts. The resulting memoir methodology encouraged people to express their thoughts and feelings about their own experiences and situations so that they could be used in sociological analysis. In the following years, George took over and extended this theory and adapted its memoir methodology for the study of cultural and linguistic pluralism in Australia. His 1979 book, *Culture and Education in a Plural Society*, set out a basic theory of cultural interaction in a plural society and provided the underpinning for his advocacy of multicultural policies in education.

There were three key concepts which George developed. The term group system of cultural values referred to meanings shared by members of a given ethnic group across the various areas of life. This was complemented by the concept of personal system of cultural values, which individuals constructed for themselves from the group cultural values available to them. Such personal systems enabled them to interact with others in the shared patterns of day to day living and be accepted as a member of the group. The other important concept which gained international recognition was linked to the idea that some cultural values were more important than others for the solidarity and survival of the group. George argued that such core values varied from group to group, but in most, though not all ethnic groups, they included the group’s particular language. These concepts proved most useful in research analysis, which could lead to an understanding of what was happening, at both individual and group level, to the cultures that immigrant groups had brought with them to Australia.

Over the next twenty years George embarked, with his research students, on studies of a range of different ethnic groups – Polish, Ukrainian and Croatian; Greek, Italian and Welsh; Chinese, Indian, Cambodian and Filipino; Ethiopian, Uighur and
Armenian. Collaboration with his higher degree students was a feature of George’s research output, clearly evident in the large proportion of joint publications in his record and epitomized in the book published in Polish (Harris & Smolicz, 1984), which won the Florian Znaniecki Prize of the Polish Academy of Science. Another joint study of Polish-Australian memoirs was published in both English and Polish (Smolicz & Secombe, 1981).

One of the key findings which emerged from these studies was that many children from minority ethnic groups said they would like to keep up their home language, but there was hardly any opportunity for them to do so. Demographic statistics showed clearly the generational decline in minority ethnic languages, but often this was happening not because the children wanted to assimilate to English as quickly as possible. Many deeply regretted that they did not have the opportunity to develop literacy in their home language in the same way as the school enabled them to gain literacy skills in English. Thus George’s research supported, in practical terms, his efforts to make available opportunities to learn languages other than English as part of the formal school setting. One of these was the inclusion of minority ethnic languages as fully accredited Year 12 subjects, acceptable for university entrance. Another was the establishment of the South Australian School of Languages, as an official Department of Education & Children’s Services’ school, offering over twenty languages, outside normal school hours, and open to students from all school systems. A third was the support and upgrading of the Ethnic School System to its present official recognition as a complementary provider of languages learning.

However, George’s research indicated that multicultural policies were most likely to succeed in Australia if children from the majority group also had the opportunity to learn a second a language. The study of another language could help provide insights and cultural understandings important in the acceptance of people from other cultural groups and in the positive evaluation of cultural diversity. In 1984 George was asked by the then Minister of Education, Hon. Lynn Arnold, to chair a Taskforce to Investigate Multiculturalism and Education. The first recommendation of the Report was that English plus one other language should be part of the education of every child from pre-school to university level. There was a real move to implement what was a quite revolutionary policy at the primary school level in that, with a few very exceptions, languages had not been regarded as part of the normal primary school curriculum before. Currently, implementation of the policy appears to have stalled at secondary level, except in schools linked to the International Baccalaureate, where a second language is a compulsory area of study.

Such brief resumes cannot do justice to the work of either Kevin or George. I hope, however, that they are sufficient to demonstrate the distinctive contribution of each in the development of new theoretical frameworks for their respective areas of research, as well as methodological approaches which were innovative and influential. In addition, their research had very real practical implications for schools
and teachers in the classroom. Very few researchers in education have succeeded in making a contribution at all three levels, as they did.

FACTORS EXPLAINING THEIR ACHIEVEMENT

It is worth considering what factors explain the high level of Kevin and George’s research contributions. At the most pragmatic level, there was the fact that both chose to stay at the University of Adelaide, turning down offers and opportunities available elsewhere. This had two outcomes. First, the fact that they were both in the Department through the same period was important. According to Keeves (2006), either one of them, alone, could not have created a tradition of research in education at the University of Adelaide. But together the two prolific, internationally recognised researchers with different, but mutually respected, research fields and methodological approaches could and did. Secondly, the extent of their contribution over thirty years reflects the fact that they remained in the Department longer than many others. George, in particular, outstayed the last of his 1965 contemporaries by ten years. Their achievements were greater because they stayed on; and because they stayed on together.

A second explanatory factor was their friendship and mutual respect for each other’s work. In many ways, it was a surprising and unlikely friendship. The circumstances of Kevin’s appointment and George’s election as Chair of the Department two years later could have made them the bitterest of rivals. So, too, could the differences in their research orientations.

In terms of personality and personal history, they could hardly have been more different. Kevin, for all his outward sociability, was at heart an intensely private and reserved individual, whose strategy of politely and kindly ‘inquisitioning’ those he had to deal with, worked so brilliantly that it was never necessary for him to talk about himself. George was much more out-going and spontaneous, ever ready to engage in conversation and talk about his ideas and experiences. He enjoyed interacting with people from a wide range of social and cultural backgrounds.

Their roads to Adelaide were totally different. For Kevin, school and university education in regional N.S.W. led to the opportunity for Masters studies at Havard and a PhD from Toronto (Marjoribanks, 2005). In George’s case, early childhood spent in what was then Eastern Poland led to deportation with his parents to Siberia, early education in a Polish refugee school in Teheran, primary schooling in French in Beirut, secondary education in the highlands of Scotland and a Ph D in Chemistry from Edinburgh (Secombe, 2006).

In their scholastic peregrinations, however, both had spent time at Oxford. As a postdoctoral research fellow at Lincoln College, George had revelled in the chance to sidestep into social science studies. Kevin spent the years immediately before he came to Adelaide lecturing in education at Oxford and establishing the Oxford Review of Education. Both, in my view, were profoundly influenced by their Oxford experience, which helped to shape their vision of a university.
Despite their many differences, they forged at first a working relationship and then a lifelong friendship, deeply valued on both sides. It began as an alliance to outwit the mindless authoritarianism of Professor Neal. With the introduction of elected Chairs of Departments in the mid seventies, it became co-operation to develop a working model of democratic academic governance under their leadership. Over the years the relationship flowered into a genuine friendship of opposites, based on mutual respect and acknowledgment of each other’s work and their shared vision of the university.

The words that Kevin wrote to George at the time of the latter’s retirement, “You have been the complete University Man”, epitomize the essence of their friendship and hold the key to what they had in common. For the words apply equally to Kevin himself. Both had a lifelong and, to use Kevin’s own word (Boumelha, 2006, p.14), “passionate” commitment to research in education and to sharing their research insights and methods with their students. Both believed in the University not as a business for profit, not as a production line for graduates, not as a vast computer to access knowledge, but as a community of scholars, where the meeting of minds, the personal encounter between scholar and scholar, student and student, and scholar and student was the very essence of the education process.

AN ON-GOING TRADITION OF EDUCATIONAL RESEARCH?

There is a final question that warrants consideration. What do Kevin and George’s research achievements mean for the School of Education in the future? The fears that I have in this regard justify the question mark at the end of the above heading. If we follow George’s interpretation of the term “tradition” according to humanistic sociological principles, we are led to view tradition not as the dead hand of the past, imprisoning those who come after, but rather as a resource that succeeding generations can use in their own way, as a living tradition (Smolicz, 1999, pp. 228–9).

Thus, whether an item of culture, such as doing research in education in the university context, becomes an on-going tradition depends not on the achievements of the older generation. The theses Kevin and George supervised and the articles and books they published constitute the heritage they have left for succeeding generations. It stands on its own merits, and will continue to stand across the generations to come. Whether that heritage is maintained and developed as an on-going living tradition depends rather on the younger generation of recently appointed staff, as well as staff yet to be appointed, and what they make of the educational research heritage they have received from Kevin and George.

The younger generation’s response will depend partly on their attitudes to their predecessors and their evaluation of the relevance of the research they did, and partly on the concrete reality of day to day working conditions in the university. Such mundane aspects of material reality can act as barriers, preventing positive attitudes and intentions from finding expression in action. It is this latter aspect that leads to
concerns for the maintenance of a research tradition in education at the University of Adelaide.

A glance at the current staffing profile of the School (the second footnote to Table 1) shows that the number of staff stands at seven – what it was in 1998 and at the time of George’s appointment in 1965. There are, however, two very important differences between the situation now and in those earlier periods. The first is that from 1965 until now, there have always been at least two and often three staff at the senior academic level. There is now no Professor and no Reader or Associate Professor to provide the School with the leadership and example in educational research that Kevin and George did for over thirty years.

The second difference is that for the first time in the history of education studies at the University of Adelaide, education programs are being taught at all student levels (see Table 3). In 2004 an undergraduate Bachelor of Teaching degree, designed to be studied concurrently with another degree, was introduced (University of Adelaide, 2004, p. 69–70). It has attracted high quality applicants coming directly from Year 12 studies. As a result, the School now teaches at undergraduate (B Teach), and postgraduate (Grad Dip Ed and MEd Studies) levels, as well as having three research degrees (MEd, DEd and PhD). The requirements of teaching at all these levels, plus the requests for research supervision, and the accompanying administration for all this, in addition to providing for an international student load which now stands around 20% of the total education enrolments, mean that the demands on staff have never been greater, particularly for the four out of seven recently appointed staff. With the best will in the world, it is difficult to see how they could ever find time to do the research which I know that they are deeply committed to.

For my part, it is hard not to make comparisons with the situation I enjoyed at the beginning of my own academic career, when there were two Professors and one Reader in the Department and teaching involved only two levels. I count myself most privileged to have served my academic apprenticeship in educational research and university teaching under the leadership of Kevin and George. Teaching and researching in education with them over the last thirty years has been an honour and a joy. Many other staff and students have shared that experience with me.

In conclusion, I pay tribute to two Professors of Education, who by the example of their own research, their teaching and their supervision of research students over more than thirty years, succeeded together in creating a tradition of research in education at the University of Adelaide. They changed a small department, focussed primarily on preparing secondary school teachers, into one which has become known internationally for its research on environments for learning and on cultural and linguistic diversity in education. Their students have gone out as successful research graduates into schools, colleges and universities, not only here in South Australia and other Australian states, but in the case of international students to many different countries across the globe. The achievements of Kevin and George in educational research have certainly brought great credit to the University of Adelaide and are indeed worthy of our honour and respect.
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CHAPTER 2

EFFECTS OF SOCIOECONOMIC STATUS, CLASS SIZE AND ABILITY GROUPING ON SCIENCE ACHIEVEMENT

A Sociological Approach

ABSTRACT

This study examines the effects of key social group variables (e.g. socioeconomic status, class size, ability grouping and school type) on the science achievement of secondary school students in Canberra, Australia after controlling for student level effects (e.g. prior performance, attitudes toward school, liking of science and educational aspirations). The study employed a multilevel analysis procedure to examine the data at the student, classroom and school levels for both direct effects and cross-level interaction effects. The major finding is that sociological factors in this school system operated at the classroom level, together with cross-level interaction effects operating at the school and classroom levels, with no main effects operating at the school level to explain nearly all the variability between classrooms and schools. At the student level prior achievement, socioeconomic status, attitudes and aspirations were found to be significant but a substantial amount of the variability between students was not explained. The importance of complex group effects operating within classrooms and schools as well as between classrooms, but not between schools is emphasized. Multilevel analysis at three levels advances the systematic examination of group and sociological factors as well as individual psychological factors.

Keywords: ability grouping, class size, streaming, socioeconomic status, science achievement, multilevel analysis, tracking

INTRODUCTION

During the second half of the twentieth century the expansion of middle and lower secondary education that resulted from staying longer at school led to the growth in

This paper was presented at the Celebrating Excellence in Teaching and Scholarship (CETS) organised by the University of Adelaide in honour of the late Emeritus Professor Kevin Marjoribanks.
most developed countries of comprehensive schooling rather than the maintenance of selective schools of an academic nature for the more able, together with vocational schools for the less able. However, within the comprehensive schools students were commonly grouped according to indicators of their intellectual ability into so-called ‘streams’ or ‘tracks’ with different curricula and different methods of instruction. During the past 40 years, there has also been marked expansion of education at the upper secondary school level in many countries, so that there is an expectation that 90 per cent of an age cohort will remain at school to the terminal stage and experience 12 years of schooling. It is apparent that comprehensive schools with their ability grouping practices, while generally viewed as more democratic than selective schools, cannot be expected to remain functional for the next 40 years. Nor can the bureaucratic structures of public education systems be expected to operate unchanged with the growth of non-government schools and the movement towards self-governing and self-managing schools within the government school system.

There is, however, a lack of research into the operation of schools that examines not only the structural characteristics of schools but also that considers the sociological characteristics of schools and the classroom groups that are formed within them. Nevertheless, there is growing recognition that the differences between schools in their levels of performance is relatively small, with far larger differences being found between classrooms within schools and between students within classrooms. Many factors contribute to these between and within classroom effects that are associated with class size (Finn and Voelkl, 1998), the assignment of particular teachers to particular tracks (Kelly, 2004), and the grouping effects of clustering of students according to their interests and aptitudes in classrooms (Oakes, 1994). The examination of such factors at the secondary school level has proved difficult until relatively recently. The emergence of multilevel analysis procedures (particularly, Bryk and Raudenbush, 1992) make it possible to investigate systematically effects at three levels of analysis, the school, classroom, and student levels, as well as the cross-level interaction effects of school and classroom factors on student-level variables. Furthermore, the emergence within the government school system of large-scale testing programs that are now moving up to the middle secondary school stage are beginning to make possible large-scale meaningful studies of factors influencing educational outcomes. It would seem essential that before substantial structural changes are made to the school system at the middle and upper secondary school levels, that run the risk of being ideologically driven, rather than research based, the findings from strong research studies are made available to guide and monitor change over the decades ahead. This paper seeks to provide guidance for the design of research studies that can be carried out to investigate the many factors that operate at different levels of schooling.

This article is written to reflect the interest of Kevin Marjoribanks in family status as well as educational policy and practice. One of his major contributions to educational research methodology involved the examination and portrayal of interaction effects. In this article we develop the idea of interaction effects in the search for cross-level interactions between factors associated with schools and
classrooms and characteristics of the students. This search has recently become possible through advances in multilevel and multivariate analysis, and this article is presented with this emphasis as a tribute to the research and scholarly writing of Kevin Marjoribanks in the field of the Sociology of Education.

A REVIEW OF PREVIOUS RESEARCH

The aim of this study is to investigate the effects of ability grouping and class size on science achievement of secondary school students after controlling for student-level factors (e.g. ability level, socioeconomic status, attitudes and aspirations), class-level and school-level factors. At the school-level, ability grouping can generally be defined as the practice of separating students into classrooms groups “according to indicators of their intellectual ability” (Oakes, 1994, p.6). However, in secondary schools, ability grouping may take several forms ranging from assigning students to the same ability-grouped classes for all academic subjects, to assigning students to different ability-grouped classes for different subjects, and to assigning students to small ability groups within the class (see Slavin, 1990a, pp. 471–2).

The main rationale behind ability grouping is to reduce ability heterogeneity so as to enable teachers to tailor instruction to the ability levels of most of the students in the class or group (Slavin, 1987; Burns & Mason, 2002). This practice has stimulated much theoretical and implementation debate (e.g. see Slavin, 1987, 1990a&b, 1995; Hallinan, 1990; Barr, 1994; Jaeger & Hattie, 1995; Shields, 1996; Tieso, 2003) and as a consequence, not all educators, school administrators or school systems favour ability grouping. This difference in practice among schools has led to the evolution of the term ‘streaming’ in schools to differentiate between schools that practice ability grouping from those that do not practice ability grouping, called ‘non-streamed’ schools (Slavin, 1990a; Barr, 1994). Schools that stream often have two types of classes; low track classes that consist of students perceived to be low achievers and, high track classes that consist of students perceived to be high achievers. Generally, performance on intelligence tests or selected subjects (e.g. Mathematics and English) as well as teachers’ judgments are often used in assigning students to either the low or high ability classes (Holmes & Ahr, 1994; Oakes, 1994; Burns & Mason, 2002). These classes with different levels of ability are frequently involved in the study of different combinations of subjects, which lead to different career pathways. As a consequence, the term ‘tracking’ is now widely employed, in order to emphasize this aspect of practice and to divert attention from the ability grouping procedures employed. In addition, Kelly (2004) has argued that teachers may also be tracked in situations where tracking of students occurs with an associated increase in the inequalities in opportunity to learn.

Arguments for and against ability grouping are extensively recorded in the literature (e.g. Slavin, 1990a). On the one hand, arguments for ability grouping generally claimed that the good students learned faster when they were taught separately, and that weak students profited from being taught in classes where teachers targeted instruction (with respect to content, pace and methods) to their
deficiencies (Oakes, 1994). On the other hand, arguments against ability grouping stated that this practice created opportunities for schools and teachers to discriminate against low ability students. Indeed, it has generally been argued that "students in high-ability classes receive more or higher-quality instruction, have more motivated or better qualified teachers, and/or have the benefit of high-ability classmates who contribute to an academic climate that is better than that experienced by students in lower-ability classrooms" (Burns & Mason, 2002, p. 229). In addition, it has been argued that, when compared with students in low-ability classes, students in high-ability classes were exposed to a more positive normative climate (i.e. better aspirations, self-concepts, and attitudes) of classmates (e.g. Slavin, 1990a; Burns & Mason, 2002) and of teachers (e.g. Hallam & Ireson, 2003). Ireson and Hallam (1999) reviewed research and questioned the benefits of ability grouping on both academic and non-academic outcomes for pupils, including self-esteem, and attitudes towards school.

There is considerable disagreement in scholarly writing regarding the effects of ability grouping on student achievement. Some studies reported that ability grouping had small positive effects on average achievement of both low and high track classes (e.g. Kulik & Kulik, 1982) while others concluded that this practice boosted the performance of high ability students and hinder that of low ability students (e.g. Oakes, 1982; Kerckhoff, 1986; Sorensen & Hallinan, 1986; Gamoran & Mare, 1989). However, some studies reported that no groups of students benefited from being in tracked classes (e.g. Slavin, 1990a; Kanihan et al., 2003).

One feature commonly not taken into consideration in ability grouping studies, is that schools which naturally draw students of a common level of ability, largely as a result of the characteristics of the community served by the school, do not need to employ ability grouping or tracking in the sorting of students into classes. The variable of school or class level variance on an independent achievement test provides an indicator of the homogeneity of the community from which the school draws its students, with a similar variable operating at the class level. While both variables are likely to be related to average socioeconomic status at the school and classroom levels, these measures of school and classroom variance have clear sociological meanings.

Numerous studies have examined the relationship between ability grouping and student achievement. However, few studies have attempted to examine the effects of ability grouping and class size on student achievement. A recent study carried out by Nye et al (2004) examined the effects of class size on reading and mathematics achievement of low achieving students using data from Project STAR, a four-year, large-scale randomized experiment on the effects of class size in Tennessee, United States. In that study, Nye and her colleagues employed hierarchical linear modelling techniques and found no evidence for differentially larger (interaction) effects of small classes for lower achieving students at the primary school level. However, like most other class size studies, the students in Nye’s study were not ability grouped.
This current study employs a hierarchical linear modelling technique to examine, in particular, the effects of ability grouping and class size on science achievement of secondary school students using data collected from 1,984 students in 71 classes in 15 schools in Canberra (Keeves, 1972). In addition, the analysis is able to include other sociological factors, such as the socioeconomic status of the school and classroom groups, and the type of school that have sociological links.

The analysis undertaken in this paper employs multilevel procedures to examine not only the effects of the organizational variables, but also the influence of the sociological or group measures at the classroom and school levels, after the effects of prior achievement, psychological factors, and socioeconomic status have been allowed for at the student level. The analysis also provides for cross-level interaction effects, to estimate the influence of the characteristic of the groups on the performance of individuals having particular characteristics. Such relationships are sometimes referred to as ‘frog-pond’ effects and are more generally referred to as ‘contextual’ effects, as distinct from ‘configural’ effects that involve the direct effects of student characteristics aggregated to the group levels of the classroom or school.

These relationships are of particular interest when such sociological variables are involved since they are concerned with the effects of the groups on the types of individuals within the groups for the contextual effects, and directly at the group level for the configural effects.

The structure of this paper is as follows. A section is included in which the data involved are described. Two sections are provided in which the hypothesized hierarchical linear model is described and specifications of this model outlined. The analyses are then described and, finally, sections containing the results of the analyses are presented and interpreted.

DATA

It has been mentioned in the introductory section that the data for this study were collected from 1,984 junior secondary students in 71 classes in 15 schools in Canberra, Australia. Information was obtained about individual student socioeconomic status (father’s occupation), work aspirations (expected occupation), educational aspirations (expected education), academic motivation, attitudes towards science (like science), attitudes towards school in general (like school), self-regard, prior science achievement and final science achievement (outcome).

These data were obtained from a population of nine government schools, four Catholic schools and two independent schools. Six of these schools were single sex schools (three boys’ and three girls’ schools) and nine were co-educational schools. In addition, 10 out of the 15 schools had a streaming policy of placing students in classes according to their abilities and academic achievement levels and the other five schools had no such streaming policy. For the streamed schools, it is worth noting that the classes for high achieving students were in most cases
much larger when compared to the classes for low achieving students in the same school. In other words, for effective teaching, the better students were taught in large groups and the weaker students were taught in small groups. However, in some other schools the better students were sometimes taught in smaller groups because the administrators of the school wanted the more able students to excel.

**HYPOTHEZED MODEL**

When dealing with multilevel data such as the data in this study, the appropriate procedure is to specify multilevel models, “which enable the testing of hypotheses about effects occurring within each level and the interrelations among them” (Raudenbush and Bryk, 1994, p. 2590). Testing of hypotheses in multilevel models can be carried out using multilevel data analysis software such as HLM5 (Raudenbush et al., 2000a). The HLM program was initially developed to find a solution for the methodological weakness of educational research studies during the early 1980s, which was the failure of many analytical studies to attend to the hierarchical, multilevel character of much of educational field research data (Bryk and Raudenbush, 1992). This failure came from the fact that “the traditional linear models used by most researchers require the assumption that subjects respond independently to educational programs” (Raudenbush and Bryk, 1994, p. 2590). In practice, most educational research studies select a sample of students who are nested within classrooms, with the classrooms in turn nested within schools, and the schools within school systems. In this situation, the students selected in the study are not independent, but rather nested within organizational units and ignoring this fact can result in the problems of aggregation bias and misestimated precision.

Figure 1 shows the three-level model proposed for testing in this study. For simplicity of presentation, Figure 1 does not include illustrations of any hypothesized cross-level interaction effects but in the actual analyses cross level interaction effects are examined. It can be seen in Figure 1 that there are 8, 10 and 17 variables that are initially hypothesized to influence directly student achievement in science at the student, class and school levels respectively. Apart from Class size (FSIZE) and Class prior achievement variance (CPRVAR), all the other variables examined at the class level and most of the variables examined at the school level were constructed by aggregating the student level data. For example, student level data on the variable Father’s occupation were aggregated at the class level in order to construct the variable Average fathers’ occupation at the class level (FOCC_2) while student level data on this variable were aggregated to the school level in order to construct the variable Average fathers’ occupation at the school level (FOCC_3).
Figure 1. Three-level hierarchical model of factors influencing Science achievement.
Table 1. Variables tested at each level of the hierarchy

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable code</th>
<th>Variable code</th>
<th>Variable description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-1</td>
<td>FOCC</td>
<td>Father's occupation (1=Professional, . . . , 6=Unskilled labourer)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPOCC</td>
<td>Expected occupation (1=Professional, . . . , 6=Unskilled labourer)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPED</td>
<td>Expected education (1=Year 10 and Below, . . . , 6=Higher Degree)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACAMOT</td>
<td>Academic motivation (0=Lowest motivation, . . . , 40=Highest motivation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIKSCH</td>
<td>Like school (0=Likes school least, . . . , 34=Likes school most)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIKSCI</td>
<td>Like science (1=Likes science least, . . . , 40=Likes science most)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SELREG</td>
<td>Self regard (1=Lowest self regard, . . . , 34=Highest self regard)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRIORACH</td>
<td>Prior science achievement (0=Lowest score, . . . , 25=Highest score)</td>
<td></td>
</tr>
<tr>
<td>Level-2</td>
<td>CSIZE</td>
<td>Class size (8=Smallest, . . . , 39=Largest)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPRVAR</td>
<td>Class prior achievement variance (5.09=Smallest; 18.92=Largest)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOCC_2</td>
<td>Average fathers' occupation at class-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPOCC_2</td>
<td>Average expected occupation at class-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPED_2</td>
<td>Average expected education at class-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACAMOT_2</td>
<td>Average academic motivation at class-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIKSCH_2</td>
<td>Average like school at class-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIKSCI_2</td>
<td>Average like science at class-level</td>
<td></td>
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<tr>
<td></td>
<td>SELREG_2</td>
<td>Average self regard at class-level</td>
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</tr>
<tr>
<td></td>
<td>PRIOR_2</td>
<td>Average prior science achievement</td>
<td></td>
</tr>
<tr>
<td>Level-3</td>
<td>CSIZE_3</td>
<td>Average class size</td>
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<td></td>
<td>FOCC_3</td>
<td>Average fathers' occupation at school-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPOCC_3</td>
<td>Average expected occupation at school-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPED_3</td>
<td>Average expected education at school-level</td>
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<tr>
<td></td>
<td>ACAMOT_3</td>
<td>Average academic motivation at school-level</td>
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<td></td>
<td>LIKSCH_3</td>
<td>Average like school at school-level</td>
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<tr>
<td></td>
<td>LIKSCI_3</td>
<td>Average like science at school-level</td>
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</tr>
<tr>
<td></td>
<td>SELREG_3</td>
<td>Average self regard at school-level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRIOR_3</td>
<td>Average prior science achievement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOVT</td>
<td>Government school (0=Non-Goverment; 1=Government)</td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
Table 1. Continued

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable code</th>
<th>Variable description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATH</td>
<td>Catholic school</td>
<td>(0=Non-Catholic; 1=Catholic)</td>
</tr>
<tr>
<td>IND</td>
<td>Independent school</td>
<td>(0=Non-Independent; 1=Independent)</td>
</tr>
<tr>
<td>BOYS</td>
<td>Boys school</td>
<td>(0=Girls &amp; Co-ed; 1=Boys only)</td>
</tr>
<tr>
<td>GIRLS</td>
<td>Girls school</td>
<td>(0=Boys &amp; Co-ed; 1=Girls only)</td>
</tr>
<tr>
<td>COED</td>
<td>Co-educational school</td>
<td>(0=Boys only &amp; Girls' only; 1=Co-ed)</td>
</tr>
<tr>
<td>STREAM</td>
<td>Streaming in school</td>
<td>(0=No streaming; 1=Streaming)</td>
</tr>
<tr>
<td>SPRVAR</td>
<td>School prior achievement variance</td>
<td>(8.80=Smallest; 19.46=Largest)</td>
</tr>
<tr>
<td>Criterion</td>
<td>POSTACH</td>
<td>Final Science Achievement</td>
</tr>
</tbody>
</table>

Because the main rationale behind ability grouping is to reduce ability heterogeneity, it would follow that one of the important factors that influences whether or not a school would decide to introduce streaming should involve the spread of ability of the students within the school. If the variance of student ability were small, then there would seem to be little to be gained from separating the students into high and low ability classes. However, if the variance of student ability were large, then not only would the task of separation be easier, but it could be argued that the teaching of high and low ability students could be undertaken more effectively in separate classes.

Consequently, in this study a decision was made to use variance in prior achievement as a variable at the school-level in order to explain student achievement. It is also of interest to examine the effects of variance at the class-level in order to examine whether an effect associated with the homogeneity or lack of homogeneity of the class groups can be detected. Class prior achievement variance (CPRVAR) and School prior achievement variance (SPRVAR) were constructed by calculating the variance in students’ prior achievement scores at the class and school levels respectively. Hence, these variables are measures of degree of ability homogeneity (or heterogeneity) at the class and school levels respectively, and have sociological meanings that are related to the communities served by the schools.

The names, codes and description of the predictor variables tested for inclusion at each level of the three-level (Figure 1) model have been provided in Table 1. The large numbers of variables listed at Level 2 and Level 3 in Table 1 and Figure 1, merely indicate that these variables were screened prior to entry into the regression equations. Few, however, had significant effects, and there was no danger of overfitting variables to the data at the school level.
ANALYSES

The first step in multilevel analyses was to run a so-called ‘null model’ in order to obtain the amounts of variance available to be explained at each level of the hierarchy (Bryk and Raudenbush, 1992). The null model contained only the dependent variable (Science achievement, POSTACH) and no predictor variables were specified at the class and school levels. The null model can be stated in equation form as follows.

Level-1 model

\[ Y_{ij} = \pi_{0jk} + e_{ij} \]

Level-2 model

\[ \pi_{0kj} = \beta_{00j} + r_{0kj} \]

Level-3 model

\[ \beta_{00j} = \gamma_{000} + u_{00j} \]  

Equation 1

where:

- \( Y_{ij} \) is the science achievement of student \( i \) in class \( k \) in school \( j \);

The second step undertaken was to estimate a Level-1 model, that is, a model with student-level variables as the only predictors in Equation 1 above. This involved building up the student-level model or the so-called ‘unconditional’ model at Level-1 by adding student-level predictors to the model, but without entering predictors at any of the other levels of the hierarchy. At this stage, a step-up approach was followed to examine which of the eight student-level variables (listed in Table 1) had a significant (at \( p \leq 0.05 \)) influence on the outcome variable, POSTACH. Four variables (FOCC, EXPED, LIKSCI and PRIORACH) were found to be significant and therefore were included in the model at this stage. These four student-level variables were grand-mean-centred in the HLM analyses so that the intercept term would represent the average POSTACH score for the schools (see Kreft, Leeuw, & Aiken, 1995). In addition, the estimated coefficients LIKSCI were fixed at the class and school levels because the reliability estimates of these variables were below 0.10 (see Raudenbush et al., 2000b, p.97).

The third step undertaken was to estimate a Level-2 model, which involved adding the Level-2 or class-level predictors into the model using the step-up strategy mentioned above. At this stage, the Level-2 exploratory analysis sub-routine available in HLM5 was employed for examining the potentially significant Level-2 predictors (as found in the output) in successive HLM runs. Following the step-up procedure, two class-level variables (CSIZE and PRIOR_2) were included in the
EFFECTS OF SOCIOECONOMIC STATUS, CLASS SIZE AND ABILITY GROUPING

model for the intercept. In addition, two cross-level interaction effects (one between PRIORACH and LIKSCH_2, and the other between PRIORACH and CSIZE) were included in the model.

The final step involved building up the model to the school level through adding the significant school-level predictor variables into the model using the Level-3 exploratory analysis sub-routine and the step-up strategy. At this stage, five cross-level interaction effects were included in the model.

The final model at Levels 1, 2 and 3 can be stated as follows.

**Level-1 model**

\[ Y_{ijk} = \pi_{0kj} + \pi_{1kj}(FOCC)_{1ikj} + \pi_{2kj}(EXPED)_{2ikj} + \pi_{3kj}(LIKSCI)_{3ikj} + \pi_{4kj}(PRIORACH)_{4ikj} + e_{ikj} \]

**Level-2 model**

\[
\begin{align*}
\pi_{0kj} &= \beta_{00j} + \beta_{01j}(PRIOR-2)_{01kj} + \beta_{02j}(CSIZE)_{02kj} + r_{0kj} \\
\pi_{1kj} &= \beta_{10j} + \gamma_{101j}(CATH)_{101kj} + \gamma_{102j}(PRVAR)_{102kj} + u_{10j} \\
\pi_{2kj} &= \beta_{20j} + \gamma_{201j}(STREAM)_{201kj} + \gamma_{202j}(SPRVAR)_{202kj} + \gamma_{203j}(SPRVAR)_{203kj} + \gamma_{204j}(SPRVAR)_{204kj} + u_{20j} \\
\pi_{3kj} &= \beta_{30j} + \gamma_{301j}(FOCC-3)_{301kj} + \gamma_{302j}(FOCC-3)_{302kj} + \gamma_{303j}(FOCC-3)_{303kj} + \gamma_{304j}(FOCC-3)_{304kj} + u_{30j} \\
\pi_{4kj} &= \beta_{40j} + \gamma_{401j}(FOCC-3)_{401kj} + \gamma_{402j}(FOCC-3)_{402kj} + \gamma_{403j}(FOCC-3)_{403kj} + \gamma_{404j}(FOCC-3)_{404kj} + \gamma_{405j}(FOCC-3)_{405kj} + \gamma_{406j}(FOCC-3)_{406kj} + \gamma_{407j}(FOCC-3)_{407kj} + \gamma_{408j}(FOCC-3)_{408kj} + u_{40j} \\
\pi_{5kj} &= \beta_{50j} + \gamma_{501j}(FOCC-3)_{501kj} + \gamma_{502j}(FOCC-3)_{502kj} + \gamma_{503j}(FOCC-3)_{503kj} + \gamma_{504j}(FOCC-3)_{504kj} + \gamma_{505j}(FOCC-3)_{505kj} + \gamma_{506j}(FOCC-3)_{506kj} + \gamma_{507j}(FOCC-3)_{507kj} + \gamma_{508j}(FOCC-3)_{508kj} + \gamma_{509j}(FOCC-3)_{509kj} + u_{50j} \\
\end{align*}
\]

**Level-3 model**

\[
\begin{align*}
\beta_{00j} &= \gamma_{000} \\
\beta_{01j} &= \gamma_{010} \\
\beta_{02j} &= \gamma_{020} + \gamma_{021j}(CATH)_{021j} + \gamma_{022j}(PRVAR)_{022j} + u_{02j} \\
\beta_{10j} &= \gamma_{100} + \gamma_{101j}(STREAM)_{101j} + u_{10j} \\
\beta_{20j} &= \gamma_{200} + \gamma_{201j}(STREAM)_{201j} + u_{20j} \\
\beta_{30j} &= \gamma_{300} \\
\beta_{40j} &= \gamma_{400} + \gamma_{401j}(FOCC-3)_{401j} + u_{40j} \\
\beta_{41j} &= \gamma_{410} \\
\beta_{42j} &= \gamma_{420}
\end{align*}
\]

Equation 2

RESULTS

Estimates of fixed effects from the three-level model are given in Table 2 for Level-1, Level-2 and final models. The descriptive statistics of the variables included in the final models are given at the bottom of Table 2.

The results of the final estimation of variance components for the final model and the results of the analyses of the variance components obtained from the null model
are presented in Table 3 in rows ‘a’ and ‘b’ respectively. From the information in Table 3 rows ‘a’ and ‘b’, the information presented in rows ‘c’ to ‘f’ are calculated. A discussion of the calculations involved here is to be found in Raudenbush and Bryk (2002, pp. 69–95).

The results in Tables 2 and 3 are discussed next in two sub-sections. The results of the fixed effects are discussed in the first sub-section while the results of variance explained are discussed in the second sub-section. In addition, the simplified model obtained from the analysis associated with the results recorded in Tables 2 and 3 is presented in Figure 2 with the cross-level interactions that were found to be significant shown in the diagram.

Fixed Effects

At the student-level, the results in Table 2 show that Science achievement (POSTACH) is directly influenced by Father’s occupation (FOCC), Expected education (EXPED), Like science (LIKSCI) and Prior achievement (PRIORACH). When other factors are equal, students whose fathers had high status occupations (e.g. medical doctors and lawyers) outperformed students whose fathers had low status occupations (e.g. kitchen hand and cleaners). Students who aspired to pursue education to high levels are estimated to achieve better when compared to students who had no such ambitions, while students who liked science are estimated to achieve better when compared to students who did not like science. In addition, students who had high prior achievement scores are estimated to achieve better than students who had low prior achievement scores.

At the class level, the results in Table 2 show that Science achievement is directly influenced by Average prior achievement (PRIOR_2) and Class size (CSIZE). When other factors are equal, students in classes with high prior achievement scores were likely to achieve better when compared to students in classes with low prior achievement scores. Importantly, the results in Table 2 show that there is considerable advantage (in terms of better achievement in science) associated with being in larger classes. For example, based on the Level-2 model, the results in Table 2 show that Science achievement increased at a rate of 0.18 scores per one person increase in class size. Therefore, based on this model, Student 1 in a class of mean CSIZE (27.94) was expected to outperform Student 2 in a class whose size was 10 persons below the mean CSIZE (17.94) by 0.18 × 10 = 1.80 units, assuming all other factors were equal.

Nevertheless, in interpreting the effects of class size, it needs to be remembered that 10 out of the 15 schools in these data had a streaming policy could involve placing higher achieving students in larger classes and lower achieving students in smaller classes for effective teaching. Therefore, the better performance of the students in larger classes in these data is not surprising.
The results in Table 2 also show seven significant cross-level interaction effects. These cross-level interaction effects are between (a) CSIZE and CATH; (b) CSIZE and SPRVAR; (c) FOCC and STREAM; (d) EXPED and STREAM; (e) PRIORACH and FOCC_3; (f) PRIORACH and LIKSCH_2; and (g) PRIORACH and CSIZE. Figures 3 to 9 are graphical representations of these seven interaction effects. The co-ordinates for these graphs are calculated using the procedures described by Aiken and West (1996).

Figure 3 indicates that, when other factors are equal, class size had less impact in Catholic schools than in non-Catholic schools. In other words, there was a smaller advantage of being in larger classes in Catholic schools compared to the advantage of being in larger classes in non-Catholic schools. Thus, it appears that, in non-Catholic schools, the larger classes consisted of markedly higher achieving students while the smaller classes consisted of markedly lower achieving students. It is also likely that the non-Catholic schools had policies of allocating their better science teachers to the larger classes.

Figure 4 clearly indicates that class size had greater impact in schools with smaller variances in prior achievement scores than in schools with larger variances in prior achievement scores. These results are interesting because they imply that in schools with students of homogenous ability, those students in larger classes benefit possibly because they have better teachers. However, in schools with students of heterogeneous ability the students benefit from being in smaller classes. Equally interesting is the fact that, at the class-level, the variable involving class variance (CPRVAR) is not significant, and therefore the spread of ability within the class cannot be said to have a recognizable effect on student achievement.

For students in streaming schools, Figure 5 shows that students of lower status father’s occupation are equally likely to achieve as well in science as students of higher status father’s occupation. However, for students in non-streaming schools, students of higher status father’s occupation are likely to achieve better compared to their schoolmates of lower status father’s occupation. That is, father’s occupation (socioeconomic status) has a small impact on science achievement in streaming schools but has a substantial positive impact in non-streaming schools. Likewise, Figure 6 shows that expected education has less impact on science achievement in streaming schools compared to the impact of this variable in non-streaming schools. In other words, there is a clear advantage (in terms of better science achievement) for students in non-streaming schools to have higher educational aspirations.

When others factors are equal, Figure 7 shows that students in schools of higher socioeconomic status (i.e. higher status father’s occupation) are estimated to achieve at a higher level when compared to students in schools of lower socioeconomic status (SES). However, Figure 7 further reveals that, higher prior achievement scores result in a bigger increase in science achievement of students in higher SES schools compared to the corresponding increase in science achievement of students in lower
Figure 2. Three-level hierarchical model for science achievement.
Table 2. Final estimation of fixed effects

<table>
<thead>
<tr>
<th>Level</th>
<th>Criterion POSTACH</th>
<th>Level-1 model</th>
<th>Level-2 model</th>
<th>Final model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coefficient</td>
<td>S.E</td>
<td>p-value</td>
</tr>
<tr>
<td>School</td>
<td>Intercept, $\gamma_{00}$</td>
<td>28.49</td>
<td>0.25</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>PRIOR_2, $\gamma_{10}$</td>
<td>0.80</td>
<td>0.16</td>
<td>0.00</td>
</tr>
<tr>
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<td>CSIZE, $\gamma_{02}$</td>
<td>0.18</td>
<td>0.06</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Interaction with CATH, $\gamma_{01}$</td>
<td>-0.13</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Interaction with SPRVAR, $\gamma_{02}$</td>
<td>-0.04</td>
<td>0.01</td>
<td>0.00</td>
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<tr>
<td>Class</td>
<td>PRIORACH, $\gamma_{40}$</td>
<td>0.98</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Student</td>
<td>FOCC, $\gamma_{10}$</td>
<td>-0.33</td>
<td>0.12</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Interaction with STREAM, $\gamma_{101}$</td>
<td>0.55</td>
<td>0.09</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Interaction with STREAM, $\gamma_{301}$</td>
<td>0.14</td>
<td>0.01</td>
<td>0.00</td>
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<tr>
<td></td>
<td>LIKSCI, $\gamma_{30}$</td>
<td>0.98</td>
<td>0.05</td>
<td>0.00</td>
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<td></td>
<td>Interaction with LIKSCH_2, $\gamma_{401}$</td>
<td>-0.17</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Interaction with CSIZE, $\gamma_{420}$</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level-3 descriptive statistics</th>
<th>Variable</th>
<th>Level-2 descriptive statistics</th>
<th>Variable</th>
<th>Level-3 descriptive statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSTACH</td>
<td>N: 1984, Mean: 29.00, SD: 8.16</td>
<td>CSIZE</td>
<td>K: 71, Mean: 27.94, SD: 6.21</td>
<td>STREAM</td>
<td>J: 15, Mean: 0.67, SD: 0.49</td>
</tr>
<tr>
<td>PRIORACH</td>
<td>1984, Mean: 13.30, SD: 4.05</td>
<td>PRIOR_2</td>
<td>71, Mean: 12.92, SD: 2.71</td>
<td>CATH</td>
<td>15, Mean: 0.27, SD: 0.46</td>
</tr>
<tr>
<td>FOCC</td>
<td>1935, Mean: 3.07, SD: 1.47</td>
<td>LIKSCI_2</td>
<td>71, Mean: 21.37, SD: 3.03</td>
<td>SPRVAR</td>
<td>14.87, Mean: 3.20, SD: 8.80</td>
</tr>
<tr>
<td>EXPED</td>
<td>1903, Mean: 4.24, SD: 1.61</td>
<td>LIKSCH_2</td>
<td>71, Mean: 21.37, SD: 3.03</td>
<td>FOCC_3</td>
<td>15, Mean: 3.01, SD: 0.58</td>
</tr>
<tr>
<td>LIKSCI</td>
<td>1966, Mean: 20.57, SD: 9.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Variables:
POSTACH = Final science achievement
CSIZE = Class size
PRIORACH = Prior science achievement
CATH = Catholic school
FOCC = Fathers occupation
STREAM = Streaming school
EXPED = Expected education
LIKSCI = Like science
LIKSCI_2 = Level 2 variable
LIKSCI = Like school
SPRVAR = School prior achievement variance.

NOTE: negative signs for FOCC indicate superior performance of students from professional homes.
In other words, on higher SES schools prior achievement has a more positive impact on the post science achievement of students than in lower SES schools. Clearly in Figure 7 the performance of the students in the higher SES schools is greater than those in the lower SES schools. Moreover in the higher SES schools the higher achieving students learn at a faster rate than do the higher achieving students in the lower SES schools. Thus there appear to be benefits obtained from enrolment in higher SES schools even after factors associated with attitudes and structural characteristics are taken into consideration.

Figure 8 shows that prior achievement has a more positive impact in classes with a higher level of liking school. Thus, Figure 8 implies that it is advantageous for a student with higher prior achievement to be in a class in which the students on average have positive attitudes towards school.

![Figure 3. Impact of the interaction effect of Class size with Catholic schools on Science achievement.](image)
Figure 4. Impact of the interaction effect of Class size with Variance in school on Science achievement.

Figure 5. Impact of the interaction effect of Father’s occupation with Streaming in school on Science achievement.
Figure 6. Impact of the interaction effect of Expected education with Streaming in school on Science achievement.

Figure 7. Impact of the interaction effect of Prior achievement with Average fathers' occupation in school on Science achievement.
EFFECTS OF SOCIOECONOMIC STATUS, CLASS SIZE AND ABILITY GROUPING

Figure 8. Impact of the interaction effect of Prior achievement with Average like school in class on Science achievement.

Figure 9. Impact of the interaction effect of Prior achievement with Class size on Science achievement.
Figure 9 shows that, regardless of the class size, students with higher prior achievement scores (high achievers) are likely to achieve better when compared to students with lower prior achievement scores (low achievers). Nevertheless, lower achievers in smaller classes are likely to achieve better when compared to their counterparts in larger classes. However, higher achievers in larger classes are likely to achieve better when compared to higher achievers in smaller classes.

When interpreting the results presented in Figure 9 it is important to remember that 10 out of the 15 schools involved in this study had a streaming policy. It is also important to remember that, in most streaming schools, higher achievers were placed in larger classes while lower achievers were placed in smaller classes for effective teaching. Thus, it is likely that the advantage of larger classes for higher achievers can possibly rise from the competition among the students in streaming schools such that the greater the number of students in the same class, the greater the competition becomes. Such competition can challenge high achievers to work harder, resulting in better achievement by these students. On the other hand, it is likely that the disadvantage of larger classes for the lower achievers is because of work pressure on the teacher in handling such classes possibly in non-streaming schools. Obviously, the greater the number of weaker students in a class the more difficult it is for the teacher to help individual students in the class and this can lead to lower achievement.

Variance Partitioning and Variance Explained

The results in Table 3 show that the percentage of variance initially available for analysis at Levels 1, 2 and 3 are 53.3, 46.7 and 0.1 respectively. These percentages of variance of scores at the various levels of the hierarchy are the maximum amounts of variance available at those levels that can be explained in subsequent analyses. Thus, there is markedly more variance to be explained at the student and class levels than at the school in this school system.

It can be seen from the results in Table 3 that the predictors included in the final model explained 44.9 per cent of 53.3 per cent variance available at the student level and is equal to 23.9 per cent of the total variance explained at the student level. Similarly, the predictors at the class and school levels included in the final model explained respectively 44.3 per cent (that is, 95.0% of 46.7%) of the total variance and all the variance available at the school level (that is, 0.1%). Thus, the total variance explained by the predictors included in the final model is $23.9 + 44.3 + 0.1 = 68.3$ per cent, which leaves 31.7 per cent of the total variance unexplained in this model. This unexplained variance is largely at the between students within class level.

It can be seen in Table 3 that, this model explains about half of the variance available at the student level, almost all of the variance available at the class level and all of the variance available at the school level. The large percentages of variances explained at the class and school levels strongly indicate that there are very few significant factors influencing science achievement at the class and school levels that have not
been included in this model. This implies that the teacher factors, and the school organizational factors account for little variance at the school and classroom levels. There is however considerable variance at the student level left to be explained.

CONCLUSIONS

There are many interesting aspects of this analysis of the data from a school system in which close to a specified population of students is under survey across one year of school learning. While appearing to involve organizational factors such as school type, ability grouping, streaming and class size, the results clearly indicate the influence and importance of underlying sociological factors.

The main effects reported from the analysis at the student level, indicate that in addition to prior achievement, it is the sociological and psychological factors associated with the differences between students within classrooms that are having effects, namely, socioeconomic status, educational aspirations, and attitudes towards school and learning science. However, it must be noted that slightly more than half of the variance between students within classrooms is left unexplained, indicating that there are other student-level factors likely to be involved in influencing student achievement. If teachers are having an effect on the students in their classrooms, it is likely to be through positive interaction effects on some students and negative effects on others, since there is considerable variance available at the student level that is left unexplained, and there is very little variance that is not explained at the class level.

At the classroom level, about two per cent of the total variance is left unexplained, with the average level of prior achievement of the class group having a significant effect. In addition, class size has a positive effect at this level on science achievement, with students in larger classes doing significantly better than students in smaller classes. However, this effect is likely to be confounded with factors associated with the qualities of the teachers assigned to teach the larger and the smaller class groups. Perhaps, this indicates the skill of the administration of the schools, particularly in those schools that have adopted streaming practices to select the best teachers and allocate them to the higher performing students in larger classes. Furthermore, the interaction of class size and prior achievement shows that the school policy of setting up larger classes does not seem to disadvantage students who are higher achievers. Indeed, the higher achieving students in larger classes perform better than their counterparts in smaller classes. This may well indicate the effects of a competitive climate, or alternatively better teaching as a consequence of deliberate policy of allocating the better teachers to teach larger higher ability classes. Importantly, it appears that, in classes that range in size from eight students to 39 students, placing higher achievers in larger classes and lower achievers in smaller classes can help to raise the achievement of the lower achievers.

The interaction of liking school with prior science achievement indicates quite clearly that students in classes with on average very favourable attitudes towards
school who are higher in initial science achievement achieve better in science after one year at the lower secondary school level in this study.

At the school level of the analysis there are no factors directly explaining differences between schools because of the very small between school variance but there are two interesting interaction effects between class size and school-level variables. In the non-Catholic schools it is the students in the larger classes who perform noticeably better when compared to students in larger classes in Catholic schools. However, where there is a wide range of student ability and achievement in science within the school, a case can be made for the use of streaming and the teaching of less able students in smaller classes.

Cross-level interaction effects indicate that socioeconomic status and educational aspirations have little impact on the science achievement of students in streaming schools. However, in non-streaming schools, low socioeconomic status and low educational aspiring students suffer while high socioeconomic status and high educational aspiring students gain when compared with students attending schools that practise streaming. The question must be asked whether streaming is introduced or not introduced to help students from higher socioeconomic status backgrounds or students from lower socioeconomic status backgrounds.

There is much to be learnt about the reasons why school principals and teachers make organizational decisions within schools and why parents choose to send their children to schools of different types. These decisions and choices influence different students in different ways that are complex and warrant investigation. This study has not examined either the gender effects or ethnic group differences that operate within classrooms.

There is considerable debate and controversy throughout the Western World with respect to the advantages and disadvantages of ability grouping, streaming and tracking. However, it is argued in this article, using the evidence presented, that the relationships involved which are concerned with effects on achievement in science are considerably more complex than many previous studies have suggested. Most earlier studies do not seem to have taken into consideration critical sociological variables or to have sought to examine cross-level interaction effects that involve the moderation of psychological variables by such sociological variables as ability grouping, class size, class context and the variance in achievement at the school level of the students being provided for within the schools. It is clear from this study that some consideration must be formally given to the range in ability of the students within the school as to whether or not ability grouping, streaming or tracking are introduced.

Moreover, if ability grouping, streaming or tracking is undertaken, then a decision must be made as to whether it is for the benefit of the weaker students in smaller classes or the more able students in larger classes to whom the better teachers are assigned. In addition, research studies need to be undertaken with respect to the competitive press set up in classes of different sizes and whether this competitive press while being beneficial with respect to achievement, has detrimental effects on other important outcomes of schooling. It was possible that in this school system the
quality of those teachers involved in the teaching of science was high, and had little variability. As a consequence, while the variance between class groups is large, this variance is mainly explained by prior achievement, and class size and the effects of better teaching may be concealed by the assignment of the better teachers to the better students in larger classes. Nevertheless, it is clear that the complex effects of ability grouping, tracking and streaming can be teased out from longitudinal studies. Longitudinal studies within school systems with measurement being made on several occasions are clearly required, with not only achievement being assessed but with other potentially important psychological variables operating at the student level and with sociological and organisational variables at the classroom and school levels being taken into consideration.

REFERENCES


Nye, B., Hedges, L.V., & Konstantopoulos, S. (2004). Do low-achieving students benefit more from


