MEASURING THE RESOURCES ALLOCATED TO EDUCATIONAL RESEARCH AND DEVELOPMENT IN OECD COUNTRIES

Phillip McKenzie
Australian Council for Educational Research

Paper presented to the Joint OECD-CORECHED International Expert Meeting
Taking Stock of Educational Research and Development

Bern, Switzerland
1-2 October, 2007

Introduction

The first-ever international comparisons of the resources involved in educational research and experimental development (R&D) were published in the 1995 edition of *Education at a Glance: OECD Indicators*. Data on the personnel engaged in educational R&D were supplied by eight OECD countries (Australia, Austria, Finland, Ireland, the Netherlands, New Zealand, Sweden, and the United Kingdom). Information on expenditure on educational R&D was supplied by these eight countries and Canada.

The data indicated that educational R&D attracted only a small proportion of the resources used in education or in R&D activity as a whole. Expenditure on educational R&D averaged less than 0.3 per cent of total education expenditure. On average, research on education attracted only 1 per cent of the personnel and expenditure allocated to national R&D activity.

This paper outlines the process involved in preparing the 1995 indicators, reflects on the methodological issues that arose, and discusses some of the implications for future work on indicators of educational R&D.

Background to the 1995 Indicators

In 1991-92 there was a major public inquiry into the structure and funding of educational R&D in Australia. The chair was Professor Barry McGaw, who was the-then Director of the Australian Council for Educational Research (ACER). I was the executive officer and helped to prepare the final report.[1] The review used data from the Australian Bureau of Statistics (ABS) that documented R&D expenditure and personnel numbers across a number of fields. The data indicated that expenditure on educational R&D amounted to only 0.35 per cent of total expenditure on education. The inquiry put this estimate in context by noting the in the health sector expenditure on R&D comprised about 1.4 per cent of total expenditure - about four times the equivalent proportion in education, and almost six times more in absolute terms.

[1] McGaw, B., Boud, D., Poole, M., Warry, R. & McKenzie, P. (1992). *Educational Research in Australia*. *Report of the Strategic Review of Research in Education*. Canberra: National Board of Employment, Education and Training.

The Australian review argued that the relatively low level of expenditure on educational R&D was due to both demand and supply-side factors. It recommended a number of reforms aimed at ensuring that educational R&D was more sought after, valued and used by educational policy makers and practitioners, and that the quantity and quality of educational research was improved.

Similar discussions were also underway in other countries. Nisbet *et al*. (1985) included discussions of the linkages between educational research, policy and practice in 15 countries.[2] Most of country discussions made some reference to expenditure and staffing levels in educational R&D. Common themes, however, were the difficulty of defining research and the fragmented and incomplete data sources. A more detailed study was conducted by the National Academy of Education (1991) for the USA.[3] It estimated that expenditure on educational R&D amounted to about 0.5 per cent of total education expenditure.

Educational R&D was also a focus of work at the OECD and CERI in the early 1990s. This was not just in terms of an interest in R&D itself, but also as a way of characterising the national commitment to education. In response to concerns expressed by Ministers of Education about the level of investment in educational R&D, in 1991 the International Indicators of Education Systems (INES) project resolved to collect data on educational R&D.[4] One of the INES project staff, Albert Tuijnman, knew of the Australian review and R&D data, and in 1993 he asked Barry McGaw and myself if we could do something similar for INES. The Australian Government agreed to support ACER's involvement in the work.

Development of the 1995 Indicators

1. Use of existing data, rather than collecting new data

The first decision reached was that INES would not collect any new data on educational R&D, as that would be potentially complex, costly and time consuming. Rather, the intention was to use material already collected on a regular basis by OECD member countries on R&D activities, and to extract from that the data relating to education.

The commonly accepted basis for international comparisons of the resources allocated to R&D is the OECD's *Standard Practice for Surveys of Research and Experimental Development*, (the "Frascati Manual"). The Manual provides extensive guidance on the issues associated with defining, identifying and measuring R&D activities. It has been widely used since the early 1960s and is frequently revised and updated.[5] Those data collections offered the benefits of well-tested definitions and data collection procedures, and results that should be broadly comparable on an international basis.

The Frascati Manual used for the indicators defined R&D as comprising "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications". As defined by Frascati, the key distinguishing characteristics of R&D are *originality* and *investigation* as a primary objective. Activities should only be classified as R&D if they are undertaken as an integral part of a specific research project or undertaken for the benefit of a specific research project.

[2] Nisbet, J., Megarry, J. & Nisbet, N. (Eds) (1985). *Research, Policy and Practice. World Yearbook of Education 1985.* London: Kogan Page.
[3] National Academy of Education. (1991). *Research and the Renewal of Education.* Stanford, Calif.: National Academy of Education.
[4] OECD (1991). *Handbook for the INES Project.* Paris: OECD/CERI.
[5] Preparation of the 1995 indicators was based on the 1993 edition of the *Frascati Manual* published by OECD. The 2002 edition of the *Frascati Manual* was published in 2003.

The key organising principle of the Frascati Manual is that data on R&D should be collected directly from the organisations, institutions and individuals that actually perform the R&D activities. A further principle is that the data should be collected and reported in as disaggregated a form as possible. Disaggregated data provide the opportunity to assess the completeness of the material and the sources and methodologies that have been used.

The trade-off from using the Frascati approach was that those data were limited to measuring the inputs to R&D, and could not provide any information on the outputs or impact of educational R&D. However, it was recognised that such information would be very difficult to obtain within individual countries, let alone on an internationally comparable basis. Rather, the emphasis was on using educational research expenditure and total personnel involved as proxies for the R&D effort. INES indicated, though, that indicators of the processes and outcomes of educational R&D should also be developed over the longer-term.

The initial task was to determine whether a sufficiently large number of OECD countries identified 'Educational Sciences' as a Field of Science and Technology (FOST) in their national R&D collections based on the Frascati Manual and, if so, whether they would participate in a pilot study. We already knew that the Australian data on educational R&D collected by the ABS used the OECD's Frascati methodology, and needed to explore which other countries had comparable data.

2. The 1993 feasibility study

ACER participated in a meeting of the INES Technical Group in early 1993 at which the purposes and approach were outlined and countries were invited to participate on a pilot basis. Staff members from the OECD's Directorate for Science, Technology and Industry (DSTI) who were responsible for the Frascati Manual and data on R&D also took part in this initial meeting, and supported the work throughout the whole project.

Eight countries agreed to take part, and a notional "Network E" was created to manage the work. One of the major challenges evident at this stage was that in most cases the relevant data were collected and held by the national statistics agency, rather than by the national Ministry of Education. This meant that the usual networks of communication used within countries by INES needed to be supplemented by networks connecting officials across other government departments and agencies. DSTI was very helpful in this process.

The feasibility study revealed that there were three possible situations in regard to the position of education within national R&D collections:

1. The national R&D collection identified Educational Sciences as a FOST.

2. The national R&D collection did not separately identify Educational Sciences, but knowledge of the institutions and programs included in the national collection enabled education data to be extracted.

3. The national R&D collection provided no guidance on educational R&D and alternative data sources had to be used.

Despite a number of shortcomings and limitations in the data (discussed below), six of the eight countries in the feasibility study were classified into either of the first two groups: Australia; Austria; Canada; the Netherlands; Sweden; and the United Kingdom. This meant that they were able to provide data on educational R&D that was consistent with the Frascati Manual.

Switzerland and the USA were in the third group. Although both countries were able to provide quite a deal of data on various elements of expenditure and personnel for educational R&D, the data came from a variety of different and incomplete sources. In neither country was it possible to identify educational R&D in a manner consistent with the Frascati guidelines.

The feasibility study indicated that some countries also collect R&D data classified by Socio-Economic Objectives (SEO), which are intended to identify the principal area of expected national benefit. However, the Frascati Manual did not include education as a separate SEO. Despite this, several countries did identify education as a separate SEO. The practical consequence is that educational R&D activities identified in SEO terms are generally broader in scope than those classified in terms of FOST. However, since most countries did not use the SEO classification for education, it was decided to base the work on the FOST classification.

Based on the results of the feasibility study, INES decided to include indicators of educational R&D in its 1994 data collection. Although it was recognised that the majority of OECD countries may not be able to provide the necessary data, there were two reasons for proceeding:

- It was hoped that the publication of educational R&D data from some countries in *EAG* would encourage other countries to ensure that education could be identified in their future national R&D surveys.

- It was hoped to contribute to future development of the Frascati Manual so that national R&D collections would better reflect the particular nature of educational R&D.

3. The 1994 data collection

To support the 1994 data collection, a 15-page set of guidelines was developed by ACER in consultation with INES.[6] The guidelines were sent to countries via the INES National Co-ordinators in the same manner as the collections for other indicators, and thus the educational R&D indicators were fully integrated into the regular INES process. This seen as important in order to facilitate communications, minimise data reporting burdens, and apply the INES data quality assurance protocols.

The guidelines provided:

- A rationale for collecting data to construct educational R&D indicators. The rationale emphasised the importance of R&D for education as a whole, and the potential for improving educational R&D from mapping the resources that it involved.

- Detailed definitions from the Frascati Manual of: R&D; the activities that are included in R&D; the sectors in which R&D is conducted; and Educational Sciences as a FOST. The discussion of the definitions was illustrated by their applications to education in the 1993 feasibility study.

- The approach to measuring the number and type of personnel resources engaged in R&D as detailed by Frascati, and its application to education based on the feasibility study.

- The approach to measuring the level and distribution of expenditure on R&D as detailed by Frascati, and its application to education based on the feasibility study.

[6] McKenzie, P. & McGaw, B. (1993). *Educational Research and Development: Indicators of Financial and Personnel Resources. Guidelines for Data Collection and Analysis*. Paris: INES, OECD/CERI.

Because the countries were broadly familiar with the approach through the feasibility study, and the guidelines had been field tested, countries reported few difficulties in locating the likely source of data (i.e. the national R&D survey) or in checking whether Educational Sciences was identified as a FOST. The difficulties arose in addressing the particularities of each country's circumstances, and in collating the data in a way that was internationally comparable. In the end, data were only included for nine OECD countries although 13 countries did supply data of some kind.

The 1995 Indicators and their Interpretation

The main educational R&D indicators included in *Education at a Glance 1995* are reproduced in the Appendix to this paper. Table 1 shows the personnel numbers involved in educational R&D (expressed in person-years), and Table 2 provides data on expenditure on educational R&D. Both tables express the inputs in absolute terms and also as percentages of total education and R&D activity.

As is evident in the notes to the tables, and the more detailed country information included in the Annex to EAG 1995, the indicator data need to be treated cautiously. The problems of estimating both the denominator and numerator terms in such indicators suggest that small differences among countries in ratios (e.g. the % of total education expenditure that is allocated to educational R&D) should be treated with particular caution.

The main problem areas encountered with the country data were as follows.[7]

- The countries did not use consistent approaches to the inclusion of post-graduate students as part of educational R&D personnel (or expenditure). Only two countries (Australia and the UK) included all post-graduate students studying for a research-based qualification. Others included only those post-graduate students employed by a university (Austria, the Netherlands and Sweden), or in receipt of specific grants (Finland), or studying for a PhD (Ireland). New Zealand did not include post-graduate students at all. The exclusions are likely to be significant, as post-graduate students in Australia and the UK were estimated to comprise 47% and 35% respectively of the FTE personnel involved in educational R&D.

- Most countries had difficulties in estimating the proportion of academic staff time that is allocated to educational R&D. Some based their estimates on special surveys of academic staff, while others used more ad-hoc estimation methods. Since most educational R&D is conducted by university academics, estimates of their research time can have a major impact on the total estimates.

- Estimates of expenditure appear to be particularly problematic. Although the Frascati Manual asks that both recurrent and capital expenditure for R&D (including land and buildings) are reported in full in the period in which they occur (and depreciation is excluded), countries were inconsistent in the ways that they report capital expenditures and overheads. Because capital expenditures tend to be 'lumpy' there is also the problem of particularly large (or small) expenditures in any one year giving a potentially misleading picture.

- Countries differ in the extent to which different sectors conduct R&D. For example, in those countries where Business Enterprises conduct little R&D, education can appear to be a relatively large component of R&D activity as a whole. The converse also applies.

The guidelines provided to support the work on educational R&D asked countries to comment on the quality and comprehensiveness of their educational R&D data. The guidelines also listed a number of

[7] Similar problems are also likely to be evident in measuring other fields of R&D.

questions that countries were asked to address when compiling their data. However, most countries did not supply any such information or provided only limited supporting documentation. Thus, it was a difficult and time-consuming process to check and verify the data that were provided.

Over and above these difficulties in interpreting particular country circumstances, there were four more general concerns about the Frascati Manual as it applied to measuring educational R&D:

1. Research conducted by teachers in schools was not counted as part of educational R&D except where it was directed towards a higher degree in a university.

2. In countries where teacher education courses were conducted in institutions where academic staff were not normally expected (or funded) to do research, the R&D activities of such staff would probably not have been counted because they were not surveyed.

3. Educational Sciences was not identified as a FOST in regard to R&D activity in the Business Enterprises sector. Thus, even though some enterprises may have been investing substantial amounts in R&D on better ways to educate their workforce, such activities would not have been counted as educational R&D.

4. It is likely that some educational R&D is not classified by institutions and organisations as applying to the FOST of 'Educational Sciences' but rather as applying mainly to other fields such as psychology, languages and humanities.

To the extent that these concerns apply, they would result in an under-estimation of the volume of resources allocated to educational R&D Nevertheless, the extent of under-estimation would need to be very substantial to make any significant difference to the overall conclusions from the work. Despite the conceptual and empirical problems associated with measuring R&D activity in general, and educational R&D in particular, there was a large measure of consistency among countries in the estimates that were provided. Judged in terms of personnel resources and expenditure, educational R&D seemed to be only a minor activity within education and within R&D as a whole. Of course, when assessing educational R&D it is important to focus on more than inputs -- research should be judged in terms of its contribution to knowledge, policy and practice. However, the 1995 indicators suggested that the level of resources were so low that educational R&D may lack the mass to have much impact.

Indeed, the resources allocated to educational R&D were so low that INES decided that it was not a priority to continue reporting educational R&D data; the EAG 1995 indicators have not been repeated. Still, a decade has passed since that decision, and it could be timely to revisit the issue to see whether there have been any changes, particularly given the renewed interest in R&D's potential contribution to educational reform. A further reason for revisiting the area is that the Frascati Manual has itself evolved, and the latest edition has strengthened various methodological guidelines, in particular for improving R&D statistics in the services sector, and collecting more detailed information on human resources for R&D.[8]

Implications for Future Work on Indicators

The key decision taken in developing the R&D indicators for EAG 1995 was to use the existing national surveys of R&D based on the definitions and methodology set out in the Frascati Manual. This provided the considerable advantage of using well-tested approaches to measuring R&D that had been developed with international comparability in mind. On the other hand, this decision meant that the work was

[8] OECD (2003). *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*. Paris: OECD.

constrained to using data that had already been collected within a particular conceptual and methodological framework, and which was limited to measuring the inputs (personnel and expenditure) to the research process. However, unless countries are willing to invest the substantial resources and time needed to develop a purpose-built data collection on educational R&D, use of already existing data is the only feasible approach. Such an approach would also run the risk of losing comparability with other fields of R&D.

In this context, the key lessons from the 1995 exercise relate primarily to operational aspects of successfully using the Frascati R&D data.

1. It is important that the work is closely integrated with INES and DSTI so that well-established networks, communication strategies and quality assurance mechanisms are used.

2. It would be helpful to conduct an initial review of how many countries are now able to identify Educational Sciences as a separate FOST within their national R&D data collections, and the scope and quality of the data collected. Hopefully, the number of countries and the comprehensiveness of their data collections will have increased over the past decade.

3. Provided sufficient countries have relevant data and are willing to take part, a detailed set of guidelines should be developed. The guidelines should make clear the supporting documentation that countries need to provide in order for OECD to assess the quality of the data.

4. The data should be provided in as disaggregated a form as possible in order to help decisions about how the data should be compiled and reported for comparative purposes.

5. There should be on-going dialogue with those responsible for the Frascati Manual to ensure that the issues concerning the measurement of educational R&D outlined in this paper and other studies are considered in planning future national R&D data collections.

APPENDIX: EDUCATIONAL R&D INDICATORS IN *EDUCATION AT A GLANCE* 1995

Table 1: Personnel Engaged in Educational R&D (in full-time equivalents) and as a Percentage of Total R&D Personnel and Total R&D Personnel in the Higher Education Sector

Country	Year	Educational R&D FTE persons (a)	Total R&D FTE persons (b)	a/b (%)	Educational R&D FTE persons in higher education (c)	Total R&D FTE persons in higher education (d)	c/d (%)
Australia	1990-91	1536[1]	67796[1]	2.27	1387[1]	27082[1]	5.12
Austria	1989	160[2]	23084[2]	0.69	112[2]	6058[1]	1.85
Finland	1991	347[3]	29575[3]	1.17	337[3]	7662[3]	4.40
Ireland	1991-92	75[4]	8799	0.85	22[4]	3010	0.73
Netherlands	1991	720[2]	66710[2]	1.08	360[2]	20090[2]	1.79
New Zealand	1991-92	95[5]	8837[2]	1.08	53[5]	2326[2]	2.28
Sweden	1991-92	236[2]	53604[2]	0.44	236[2]	16810[2]	1.40
United Kingdom	1991-92	3322[1]	255000[1]	1.30	3117[1]	62000[1]	5.03

Notes:

1. Includes all post-graduate students studying for a research-based qualification.
2 Includes only those post-graduate students who are on the university pay-roll or employed by the university as a research assistant.
3 For post-graduate students a person-year is only included when financed by grants of amounts corresponding to a normal salary.
4 Includes only those post-graduate students enrolled at PhD level.
5 Excludes post-graduate students.

Source: OECD, *Education at a Glance 1995*, Indicator P41.

Table 2: Expenditure on Educational R&D as a Percentage of Total Expenditure on Education and of Total Expenditure on R&D (in millions in local currency and at current prices)

Country	Year	Educational R&D expenditure (a)	Total public and private education expenditure (b)	Total R&D expenditure (c)	a/b (%)	a/c (%)
Australia	1990-91	78	21043	5091[1]	0.37	1.5
Austria	1989	143	…	22967	…	0.6
Canada	1991-92	118[2]	49022	10289	0.24	1.1
Finland	1991	120[3]	41455	10171	0.29	1.2
Ireland	1991-92	3[3]	1638	318	0.18	0.9
Netherlands	1991	98	31340	10381	0.31	0.9
New Zealand	1991-92	7	…	644[4]	…	1.1
Sweden	1991-92	231[1,2]	100286	41352[4]	0.23	0.6
United Kingdom	1991-92	53[3]	…	12619	…	0.4

Notes:
1. Data for 1990.
2 Likely to be under-estimated since only data for the higher education sector are included.
3. Likely to be under-estimated since data are not available for the private non-profit sector. In Finland a potentially more important source of under-estimation is the lack of data on expenditure on land, buildings and other capital items for educational R&D. In Ireland, the non-inclusion of central overheads attributable to educational R&D in the higher education sector is a potentially more important source of under-estimation.
4. Data for 1991.
Source: OECD, *Education at a Glance 1995*, Indicator P42.