

SCIENCE EDUCATION RESEARCH IN PAPUA NEW GUINEA 1978-1990

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ABSTRACT

This paper presents a science/science education bibliography, to assist science educationalists interested in Papua New Guinea. 392 articles were reviewed. The bibliography was then categorised in a number of ways to indicate patterns of research productivity in various areas of science education, and at different levels of education. A questionnaire was devised to obtain information from former and current researchers in the field about their own contributions. This exercise produced some surprising information about science education research in Papua New Guinea.

INTRODUCTION

For a country with a population of three million and a land area of 460,000 square kilometres, Papua New Guinea has a number of features which make it scientifically and educationally fascinating. Its scientific interest stems from the fact that in geological terms it is a very young and active area, because it is at the junction of two of the earth's major plates. This partially accounts for the country's mineral wealth and also for the amazing diversity of its flora and fauna. The country is made up of many islands, spread over a huge area. The archipelago possesses some beautiful unspoilt: coral reefs and bountiful marine resources. The population of the territory is also extremely diverse, presenting administrators with unique educational problems when organising an educational system.

Because of the fundamentally interesting nature of Papua New Guinea's educational system and the country's scientific diversity, it was felt that the task of constructing a general scientific and science educational bibliography would be well worthwhile. This bibliography consists of a listing of articles/research relating to science' education, agriculture, science, technology and society issues and pure science (generally comprehensible to a year 12 science student) for Papua New Guinea between 1978 and the present.

This paper describes the compilation of the bibliography and also describes the changing methods used in overviewing science education research, linking it to the methods used elsewhere. A second aim is to analyse the amounts of research produced in different periods in different topic areas with a view to observing if any patterns in research productivity can be found. Thirdly, the results of a questionnaire sent to researchers known to be or to have been interested in this area will be discussed. Finally it is suggested that this study could be a model for a bibliography of science educational research in Australia.

INTERNATIONAL RESEARCH ON SCIENCE EDUCATION

Internationally, there is considerable literature overviewing research into science education; this literature varies in style, purpose and methodology. Some of these overviews are broadly based whilst others relate to specific topics, branches of science or individual countries. The author will refer to a number of such surveys published over the past two decades, which he has found of interest and which allow the reader to see this paper in context.

An early overview by Whitfield (1972) defines chemical education research in a UK context. Modifying his definition, science education research can be defined as implying a dispassionate enquiry into any aspect of the teaching and learning of science at any stage of education.

The Kiel conference of 1977 produced some useful reports on the state of science education research in different European countries. Keohane (1977) overviewed European research in science education by categorising it into groups indicating major European projects being carried out in these categories. These categories proved to be a useful starting point for the current overview. Delacote (1977) points out the difficulties of career paths for science educational researchers in France at that time, many of which could equally relate to Papua New Guinea today. In the UK, Kempa (1977) stressed the need for the active translation by teachers of educational research findings into meaningful practical action. This proposition remains one which is difficult to apply in practice.

Articles about chemical education research include those by Johnstone (1978), Kornhauser (1979), Fensham (1984) and Dawson and Letton (1989). Kornhauser refers to some two hundred and fifty papers on chemical education whilst Dawson and Letton provide a bibliography of UK science education theses from the late sixties to the present time. Physics education research appears to excite less interest but Le Grande (1967), Larkin (1981) and Terry and Williams (1982) provide good starting points. Much biology education research of the 1970s is summarised in Ayres (1982), whilst for junior science a recent bibliography of integrated science teaching (Reay, 1990) is helpful.

Kempa (1976) suggests that the direction of science education research should not be dependent on curriculum development as a justification for its existence. In developed countries science education research is justified in its own right, though its major aim of improving the practice of science teaching should never be forgotten. In developing countries, generally and in Papua New Guinea, in particular, the curriculum development link remains powerful.

Recent papers by Shymansky and Kyle (1988) and Brunkhorst and Yager (1986) indicate the vastly increased scope and vision of science education as it is developing in the eighties. There have also been a number of recent single country or regional overviews of science education research, of which the current paper is one, such as Martin and Giordan (1989) (France), Tamir (1989) (Israel) and Fraser-Abder (1989) (Caribbean) with the two last-mentioned of these being particularly valuable.

Both these papers have attempted to list all the science education research carried out in a country or region and have examined the data produced to see what patterns or deficiencies in science education research may be observed. The author believes that this method offers considerable advantages over the more random surveys of the past and that it has the capacity to supply useful information which should be used to benefit science education.

RESEARCH IN SCIENCE EDUCATION IN PAPUA NEW GUINEA

A key conference for setting directions for educational research took place in 1982 at the Faculty of Education of the University of Papua New Guinea. The opening address by Roakeina (1983) (Acting Secretary for Education) laid the ground rules which for him as an administrator had to be very

practical he wanted research that was comprehensible to administrators and which could be used to help educate children more efficiently.

The main thrust of science education research has been towards producing materials for the Curriculum Unit of the National Department of Education and in broad terms this effort has produced about one third of the total science education effort. (An addendum of most curriculum unit materials, from 1978-1985, containing 134 references, has been prepared separately). Government thus sees science educationalists as being needed for basic curriculum tasks; indeed one conclusion of the 1982 Research Director's Conference was that educational research should be policy and action orientated (Guthrie & Currin, 1983, p. 192).

A second influence on science education researchers can be traced from pure science research. In 1984 it was the turn of the science faculty of the University of Papua New Guinea to hold the Waigani Seminar. This acted as a stimulus for research, but also a stimulus for communicating the results of scientific research to the populace in general. The Seminar also pointed out that the government had no science policy for the country, but unfortunately the seminar was unable to persuade government to take any action on this matter whatsoever, and there is, to date, no national science policy for Papua New Guinea.

A SCIENCE EDUCATION BIBLIOGRAPHY: COMPILATION

Many bibliographies of either science or science education, some relating specifically to Papua New Guinea, already exist and the author has made use of a wide variety of sources. In particular, the following New Guinea references have been utilised: Wilson and Wilson (1978), Cleverley and Wescombe (1979), Wormsley (1981), Crossley (1985), Wilson and Wilson (1986) and King (1988). In addition, many journals have been searched for relevant articles and many conference papers from international and PNG conferences have been obtained. Outside Papua New Guinea, the author has searched likely journals; *Current Contents* in the physical sciences, biological sciences!! Agricultural sciences has been searched for the last few years; reference has been made to the bibliography in the Journal for Pacific History (1989); the British Education Index, the Australian Educational Index, Wilson's Index, ERIC and the CSIRO science index have been searched; finally three computer searches have been made through, A.E.I., B.E.I, and E.R.I.C In addition, almost fifty science educationalists who were known to have written about P.N.G. were sent a questionnaire asking for details of their own publications.

So far 392 publications have been identified; more are still coming to light. Some comment on the various methods used to find bibliographic material may be of interest. The Papua New Guinea educational bibliographies were an excellent starting resource. The three bibliographies cover the period 1979-1985 with increasing sophistication and coverage in each successive publication. The Wilson and Wilson (1978) science education bibliography, which was quite detailed up to 1977, provided a major reason for choosing 1978 as a starting year. The Wilson and Wilson (1986) select bibliography was also helpful, but it did not attempt to be inclusive. *Current Contents* provided pure science and pure agriculture usually outside the scope of educational indexes, but it is hoped that these references will be of value to educationalists wanting an overall view of P.N.G. science. Unfortunately only the more recent *Current Contents* have been utilised. The CSIRO science index was useful but ceased publication in 1984 with decreasing usefulness in the final years. The major

standard developed country indices and the computer searches derived from them, exhibited the usual arrogance of developed countries in that they list comparatively little of the work going on in developing countries. Nonetheless each search produced one or more articles not listed elsewhere. It will be seen however that not all periods of time in all journals or indices, have been searched equally either through unavailability of resources or of time and this has been a weakness in the compilation of this bibliography.

The criteria used for selection have been difficult to utilise consistently so there will be a measure of idiosyncrasy in the bibliography. A general wide-ranging index was the aim, which should include all aspects of science, technology, agriculture and health as well as science education. Specialist science articles which were not too technically written were acceptable (being comprehensible to a year 12 student was the criterion) though in areas where no general articles were found more complex articles were accepted. Articles in popular geographic/scientific magazines were also acceptable and these are often written by research experts trying to communicate with the public. A further aim was to leave no scientific area of Papua New Guinea life unreferenced.

THE BIBLIOGRAPHY: SOME ANALYSIS AND BACKGROUND

The numbers of papers produced on a yearly and on a two-yearly basis were obtained after compiling a listing of articles by year of publication. A very rough estimate of the numbers of mentions of P.N.G. nationals as authors or part authors has also been made. It must remain only an estimate as the nationality of authors is not usually included in the articles, but it is important that the indigenous input of research of all areas including science education be included. There was a definite increase in output of relevant articles produced between 1978 and 1984, reaching a maximum in 1984-85, after which the annual numbers of articles published have declined rapidly, now being just above the 1978 figure. This could be a mere artefact of the method of compilation, as it could be argued that in earlier years less research was published, there being less emphasis on publication within universities at that time, whilst information about later publications has not yet become available. This is possible, but in the author's view the build-up in enthusiasm for science education was a real phenomenon with the 1984 Waigani Seminar encouraging both overseas and Papua New Guinean academics to engage in and publish research. This enthusiasm led to further conferences and it was also the time when the Papua New Guinea Institute of Chemistry (a major scientific society) was founded.

National academics have been very much a minority in P.N.G. tertiary education, but the proportion of nationals has steadily increased, particularly in recent years. In the early years, nationals held junior positions within tertiary education with the higher teaching loads and relative lack of opportunities for research that this entails. However this situation has changed with more nationals in senior positions but the amount of research done by nationals does not appear to have increased. Science education does have special difficulties in that the salaries and career structure available to nationals who are both good scientists and also good educationalists are better outside the tertiary education system. It has over the years, for example, proved excessively difficult to localise even some of the science faculty positions at Goroka Teachers College, so the training in research techniques of nationals involved in science education has yet to begin at that institution.

BIBLIOGRAPHY AND CONTENT AREA

As has been previously stated, the references listed in the bibliography contain varying proportions of pure science and science education. Generally papers which contain some educational component have been classified as science education, whilst only those papers with no educational component have been classified as pure science. Table 1 classifies all papers as being pure science or science education and also classifies them by broad content area. Overall 157 papers (about one third of the total) were classified as pure science papers, and the remainder were classified as science education. Papers were also divided into 17 sub-categories relevant to the speciality within science being considered.

TABLE 1 NUMBERS OF PAPERS WRITTEN IN EACH CONTENT AREA BETWEEN 1978 & 1990

Numbers of papers			
Field	Pure science	Science education	Total
Science	6	88	94
Agriculture	11	28	39
Biology	38	6	44
Environment	6	4	10
Chemistry	16	27	43
Physics	1	18	19
Technology	24	26	50
Food technology/nutrition	8	3	11
Health/medicine	13	4	17
Geology /geography	12	1	13
Mining	17	4	21
Astronomy	1	0	1
Psychology	2	6	8
History of science	0	4	4
General	1	2	3
Anthropology / pre-history	1	2	3
TOTALS	157	235	392

Areas where there has been a lack of educational research do become very clear from these data. Biological education is under-researched, which is surprising in that biology has been considered a more popular science amongst nationals than the physical sciences. Geology education, mining education, astronomy education, history of science and basic educational psychology as applied to science education, all appear to be neglected areas. One problem with this sort of analysis is that it is tempting to look at the number of publications in each area forgetting that it is not just the quantity of research that is important but also the quality.

One way of assessing quality would be to look at the form of publication of each of the papers. For research purposes an academic PhD thesis is likely to be the most useful form of publication for future researchers, then a Master's thesis, followed by articles in refereed journals, followed by conference papers, with articles in non-refereed journals generally being considered the least useful type of publication. Using these criteria there is some weakness in terms of the quality of educational research carried out in PNG. There are only eight theses relevant to science education over the past 13 years, two at doctoral level and the remainder at Master's level. Two of the Masters

theses were obtained by PNG nationals and the remainder by overseas nationals. Science education is thus under-researched at this level. or the remaining references probably about one third are from books or refereed academic journals, whilst the majority of all publications quoted are from non-refereed journals or are conference papers. However it is for the reader to extract further detail from the bibliography on a subject basis as this can provide further evidence of strength or weakness in particular areas.

Further analysis was carried out to investigate the amounts of educational research at each of the levels of education. If we look only at the science education research which was clearly focussed on a particular level of education (196 references), then at a primary (community school) level 13% of references related to this level whilst it may be pertinent to note that 63% of Papua New Guinean children of this age group attend school (Bray, 1984, p.74). At the lower secondary level, 17% of the age group attend provincial high school (ibid.) but 27% of the science education research is aimed at this level of education. At the upper secondary /tertiary levels there is a concentration of science education research (59% of the total references) whilst the percentage of the age group attending institutions at this level is below 3% (an estimate from census figures and CHE 1983). The overall conclusion from these results is that not enough research is being done in science education at the primary level.

THE CONTRIBUTION OF SCIENCE EDUCATION RESEARCHERS

About fifty requests for information were sent to people who had been or currently are active in science education research in Papua New Guinea. Fifteen replies were received and these have been extremely helpful in providing additional items for the bibliography and particularly in producing information about articles about to be published. Generally researchers remain interested in science education in Papua New Guinea, though a number still see research as a luxury even though they may themselves have Contributed towards research in a number of ways. The replies will be analysed in more detail later perhaps when a higher return is received.

CONCLUSION

The work described in this paper had four major aims. The first was to compile a wide-ranging science education bibliography for PNG. The second was to analyse the bibliographic data; limited analysis has been carried out which indicates that:

- the amount of publication in science education reached a maximum in 1984/85;
- national academics may not be keeping up the levels of publication achieved in 1984/85;
- science education research is attracting very few people into masters or doctoral programmes involving Papua New Guinea science education research;
- areas of weakness in science education research include biology education, geology education, mining education, history of science, astronomy education and basic educational psychology;
- primary science education is under-researched.

The third aim was to send a questionnaire to interested persons. This was accomplished but there was insufficient response to undertake a detailed analysis at present. The fourth aim was to indicate that useful findings can be extracted from publicly available bibliographic data, using the case of

Papua New Guinea as an example. It is hoped that as a result of this paper others may share the opinion that the creation of an Australian science education bibliography would be a worthwhile task.

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