The Training of Science Teachers in Papua New Guinea, Paper to GTC Seminar entitled Future Perspectives on Teacher Training, National Curricula and Secondary Schooling, held at Goroka Teachers College, University of Papua New Guinea, 19-20 September 1985, published in *The Proceedings of Future Perspectives on Teacher Training, National Curricula and Secondary Schooling Seminar*, pp.158-174. (Publication date: January, 1987)

THE TRAINING OF SCIENCE TEACHERS IN PAPUA NEW GUINEA.

W.P. PALMER

GOROKA TEACHERS COLLEGE, UNIVERSITY OF PAPUA NEW GUINEA

Introduction

The Currie Report (1964) pointed out that:

> So far as any one strand in the 'seamless web' of education can be picked out as of more fundamental importance than another it is the training of teachers/probably no other activity of the Administration is quite so important as this.

Klassen (l982) has also rated teacher education highly:-

> Teacher education is a major element in a nation's hope for educational progress.

Science and technology are seen as the way forward for most countries to develop their full economic potential. To achieve this, a high level of general education is required as well as a viable indigenous scientific community. (Yeboah-Ainankwah, 1984, p. 7).

In PNG two institutions prepare secondary science teachers. One is Goroka Teachers College which offers prospective teachers a Diploma in Secondary Teaching after a two year course from Grade 12. The great majority of secondary teachers take this course. The Faculty of Education offers a small minority a Bachelor of Education course which is influential, but the remainder of this paper will refer almost entirely to the GTC diplomates.

Teacher training or teacher education

One of the two quotations in the introduction refers to teacher education whilst the other refers to teacher training. Which of the two descriptions best fits the preparation of science teachers at GTC. The question is answered by considering which of Beeby's stages of development the education system in PNG has now reached. Beeby (1966) describes the four stages of development of educational systems (stage 1, Dame School; stage 2, Formalism; stage 3, Transition; and stage 4, Meaning); these stages also describe the stages of development of the teachers who work in systems.

159

In the 1970s Musgrove (1976), Larking (1974) and Ilagi (1980) all indicated that they considered that Papua New Guinea was in the formalistic stage of development. In the mid 1980s the secondary system can be seen as moving towards stage 3 (the transition stage) where the gap between what teachers and pupils know is greater than it was formerly, allowing the pupils more latitude to ask questions, though some observers might consider teachers were still at the formalistic stage (Weeks & Guthrie, 1984: 50).

The length of the courses at GTC is still very short (2 years) compared with three or four years elsewhere and the general standard of education of students at the start of these courses is not high. The content of GTC science courses is based on the topics that teacher trainees will have to teach rather than on what staff consider educated scientists should know. In fact, Guthrie (1983) gave the general opinion of GTC teachers as ‘good teachers professionally but lacking in detailed subject knowledge’. This is the description of a teacher at Beeby’s formal stage of development. GTC courses thus seek to train more than they seek to educate, regrettable though this may be.

Science curriculum: a history

Tables 1(a) and 1(b) which follow compare and contrast the curriculum changes in science over the past twenty five years both at GTC and in the provincial high schools (PHS). significant events which may have effected the science syllabi are mentioned, as are confirmatory references. These tables may be considered as the major part of this paper. The Tables indicate:(i) that quantitative ‘hard’ science decreased from 1968 to 1978 both at GTC and in PHSs.

(ii) that “hard” science may make a “come-back” through the provision of teachers capable of teaching it, but to 1985 it has continued to decline in PHSs.

(iii) Specialisation at GTC has decreased from 1968 reaching a nadir in the period 1975-78 but has increased since then.

(iv) Generalist teaching, introduced in 1975 with the intention of bringing PNG to an educational stage of “Meaning” in fact, because of its poor administration (Field, 1981), slowed PNG’s educational progress out of the formal stage. (NB. Actually, Field used McKinnon’s (1976) five stages, but the overall interpretation is the same).

The judgments on the curriculum are value judgments, but they will be illustrated using some specific examples. The 1969 GTC year III Physics syllabus was ambitious enough to include work on quantum mechanics, electronics and relativity. These topics, which are usually considered difficult, had disappeared from GTC curriculum by 1970 and have not reappeared. The syllabus states what was taught, but not how it was taught, or what understanding trainee teachers obtained. Perhaps in this case the syllabus was simply unrealistic in its expectations. However, year 3 of the PHS syllabus in 1971 included the laws of Chemistry and equations which does not seem an unreasonable level of understanding to expect after three years of secondary science, but this was omitted in 1975 syllabus revisions. The 1969 GTC syllabus for Chemistry II was classification of subs chemical language, a bonding interpretation of the periodic table and valency, sub—atomic chemistry, electro-chemistry, energy considerations and stoichiometry This goes well beyond the present GTC year 2 course requirements.

However in 1969 trainee teachers practically specialised in science perhaps spending 16 hours per week on it and it. is only in 1985 that there is a course for just seven trainee teachers with this amount of science. In the period 1976 to 1979 teachers spent only six hours on each subject. During the whole period the same qualification (the diploma in secondary teaching) has been given, but the evidence above indicates that the scientific knowledge and skills which this diploma represents have varied widely over the period.

How are the teacher training syllabi and national syllabi interrelated? Firstly there have been no formal curricular links at least since 1975 when GTC became a part of the University of Papua New Guinea. Prior to 1975 the N.D.O.E could have insisted upon syllabus changes at GTC but there is no evidence to suggest that they used their power directly.

161

The influences have thus been indirect, a GTC staff frequently help in the writing or revision of PHS units and the curriculum Unit of the N.D.0.E. may comment upon GTC courses. Also the standards which Grade 10 students in PHSs reach is very much dependent on the academic ability and motivation of their teachers, who are in the main produced at GTC. The above explains how it is possible to have cycles of decline or more hopefully cycles of improvement. Table 1(b) indicates that science teaching in PNG may now be on cycle of improvement and the syllabus of the latest Major Science/Minor Mathematics course indicates standards of science, not achieved since the early 1970's may soon be achieved by some diplomates at GTC. What is now needed is parallel movement in the PHS Science Syllabus. When the new science text books are introduced country-wide this may indeed happen.

Problems in understanding science

The major changes in the curriculum described above seem to be the result of fundamental difficulties in understanding science experienced by national students and teachers. What are the causes of these difficulties? There seems to be no certain answer but some possible causes have been suggested which are:—

(a) Cultural. The shaping of the PHS science syllabus has used traditional local knowledge as a starting point where possible (Anon, 1981). This does not seem unreasonable since a basic principle of pedagogy is to move from the known to the unknown, yet it has its problems. Kola (l984) points out that traditional knowledge is acquired through practice by trial and error methods, whereas modern science, although requiring a knowledge base, is able to use logical explanation to predict outcomes of further ideas or experiments. Traditional knowledge is thus different in character from modern science and the two do no always fit comfortably together in a science syllabus. Secondly there is not one common culture within PNG, but there are about 700 different cultures, so there are wide variety of forms of traditional knowledge. Thus any specific use of local knowledge will only be meaningful to a small proportion of the pupils using the syllabus.

162

Finally science is basically quantitative: traditional knowledge generally is not. The PNG Science syllabus has as one of the major aims, 'exposure to scientific method' (Anon 1981). Two quotations by science teachers follow, the first of whom uses his traditional knowledge to explain his science and the second of whom appears not to have under stood the nature of science.

Modern science counts everything as if it were pigs. Anon (1981).

The trouble with you is you want to count everything. Why? Hayter (1982, p. 40)

These quotations perhaps illustrate how, depending on circumstances, local culture may help or hinder the understanding of science.

(b) Language. There are very great difficulties for learners who learn in a language other then their own. Some rise above these difficulties but for others language remains a permanent handicap. Kappey (1983) tested community school pupils with practical experiments having given them apparatus and instruction. He described the results as follows:

> In general, pupils could successfully carry out the activities required of them. They were able to follow instructions, and they showed sufficient manipulative skills. They could work out what to do and could also draw correct conclusions from their observations and thus solve practical scientific problems. But when asked to use English more extensively to explain how they arrived at their conclusions, they were generally unable to do so. They even had difficulty with the apparently simple task of describing what they did. Clearly, the pupils' difficulties arose from inadequate language ability - hardly surprising when they were using a second or even third language.

(c) The ability to make generalizations. Lancy (1979, pp.111-113) noted the problems high school students have in mathematics and science achievement. He also carefully indicated the wide diversity of cultural groups but considered that in the simplest societies, people were taught to notice differences which rather than similarities. This is a habit to difficulties is science, where the ability to make generalisations is important.

163

Kola (l984) refers to lack of ability to think which he considers to be caused by spoon-feeding at the University by lecturers and to memorisation by the students. He believes students should be trained to think. Work in PNG (Wilson & Wilson, 1981) indicates that few preliminary or foundation year students are capable of formal thought (in the Piagetian sense). The major conclusion reached is that students at this level should be given varied, rich and appropriate experiences. They should also be encouraged to think formally and express their understanding verbally to others.

(d) Other Learning Difficulties Other contributing factor to learning difficulties could be poor diet when young (Lancy, 1979), or the late age of commencement of formal education without preschool or nursery school experiences for young children. In the UK,the Plowden Committee (1966, para 344) were convinced that about five years of age was a suitable age to commence schooling and that suitable nursery schooling should be provided before this (HMSO, 1972). In PNG the National Education Strategy(1979, p. was reluctant to change the age of commencement of schooling from seven years old. The only alternative considered was to increase it to 9 years of age. There were no recommendations on nursery schooling. The lack of stimulation of PNG children prior to the age of seven in preschools or community schools could well be a factor in slower cognitive development. Further research is needed.

The reasons outlined above indicate some possible impediments to the learning of mathematics and science in PNG. The Government however is aware that there are difficulties in the learning of mathematics and science and has provided some extra resources for that purpose (NPEP, 1983, p. 45).

In the small African country of Malawi, the Government is committed to producing both expert scientists and also a better level of understanding of mathematics and science amongst ordinary people (Chimango, 1984, p. 51-53). This commitment is indicated by the secondary curriculum in which more than one third of the time is given to mathematics and science.

Even after the Waigani Seminar, the Government has not decided on a science policy nor yet even in which department such a policy would be decided (Kola, 1985). Some learning difficulties could be overcome if Government were more determined to have a science policy and pursue it energetically. Such a policy would insist upon a more quantitative secondary science curriculum and would ensure that more time in secondary schools was spent on science.

Science teaching surveys

Although research into the problems in science learning is not far advanced, there have been a number of surveys of science teaching at secondary level and some more general surveys which include science teaching. Particular aspects of five of these surveys will be mentioned so that some dynamic perspective of changes in science teaching can be obtained. The surveys being considered are:—

(a) Wilson and Wilson(1973): A survey of science teachers and materials(to be called S.T. 1973).

(b) Wilson (1978): A survey of science teachers in high schools (to be called S.T. 1978).

(c) Murphy (1983): A survey of all teachers in 49 high schools commissioned by the Faculty Planning Committee of Goroka Teachers College in 1982 to find out about areas of teacher shortage in high schools (to be called FPC 1982).

(d) Palmer (1984): A survey of new teachers who graduated in November 1982 carried out in 1983 to find out the particular problems of new high school teachers of all subjects. (to be called N.T. 1982).

(e) Wilson (1985): The Second International Science Study (SISS) Population II took place in 1984. Some early data on this very thorough survey is starting to appear (to be called SISS. 1984).

Data form a number of the above surveys has been reworked for comparison. The first theme to be considered will be the composition of the teaching force in science in terms of whether they are national or expatriate and the levels of responsibility held. S.T. 1973 indicated that almost all science teachers were expatriate at that time. ST 1978 showed the proportions of expatriate and GTC trained

165

science teachers to be approximately equal. By 1982 about 72% of practicing science teachers were nationals from GTC, 4% nationals trained at Waigani and 21% were still expatriate(FPC, 1982). In the 1982 survey the levels of appointment of science teachers were obtained, 60% of the substantive subject master and senior subject master positions were held by expatriates, so expatriates remain influential in the organisation of the teaching of science.

The number of experienced national teachers (more then 5 years teaching) has increased nearly fourfold between the 1978 and 1982 surveys. Yeboah-Amankwah (1984) pointed at the necessity of viable indigenous scientific community, so it can be seen that within the teaching profession such a community is slowly being created.

ST 1977 took place in the middle of the Generalist Teaching phase of the science curriculum’s development. It can be calculated that at this time science teachers were teaching an average of 2.7 subjects per teacher whilst by 1982 science teachers were teaching 2.3 subjects per teacher. This result shows a slow but steady move to greater specialisation in schools. In terms of the degree of shortage of science teachers, F.P.C 1982 indicated headmaster saw science teachers as number two in terms of scarcity below practical skills and equal with agriculture. Palmer (1985, p. 23) suggests that agriculture is probably the area of greatest shortage followed by English, but there is considerable flexibility within the high schools, so results vary dependent on the method of analysis used.

It is hoped that the 1984 S.I.S.S. survey will provide greater information about the organisation of science teaching in high schools and also about specific problems in science teaching and learning. Wilson (1985) analysed a small portion of SISS 1982 on the opinion of Grade 9 and Grade 10 teachers on the science syllabi. Teachers consider there is too much material in Grade 10, criticise the Grade 10 chemistry unit and were generally worried about their own science background.

166

In the NT 1982 survey, new teachers looked back on their courses and two comments on the science course at Goroka will be included as they indicate the new teachers honest realisation of the vastness of science and the lack of depth of their preparation to teach the subject.

Teacher 5

> I really enjoyed my science courses at College. But I felt I really didn’t learn things in detail—which I would really like to do especially in chemistry and physics. If ever I get a chance to study one particular area in Science I will not let it pass by.

Teacher 44

> Science is wonderful. Has helped me to understand many wonderful things that I never knew about. I am fortunate to be a science teacher. I’d love to do more science in the future using more concrete materials.

Conclusion

The message of this paper is of a “virtuous cycle’ made possible by more specialised teacher training and a longer period of training teachers more nearly the autonomous professionals of the Beeby Stage 4 which should be the aim of the education system. In parallel with this there have to be major changes in the science curriculum, making science in provincial high schools more closely reflect the true nature of science. Husen et al (1978) in a thorough survey of teacher education in developing countries expressed this idea as one of his main recommendations which was:

> A major focus of teacher training should be the development of teacher knowledge and ability in specific subject areas.

REFERENCES

Anon (1981): “Dispelling our Myths: New Breed Puts Science to the Test”, *Post-Courier*, Tuesday, 3rd November.

Beeby, C. F. (1966), *The Quality of Education in Developing Countries,* Harvard University Press, Cambridge, Massachusetts, USA.

Bunker, C. A. (1984). The Fall and Rise of Specialised Science Courses at Goroka. *The Role of Science and Technology in the Development of Papua New Guinea The Policy Dimensions, Background Papers, Volume 2*, J.R Morton(Ed), Waigani Seminar, UPNG, Port Moresby, PNG, pp. 83—95.

Bunker, C.A., and Palmer W.P. (1984). The Implementation of a Programme for the Improvement of the Academic Knowledge of New Teachers of Science, *International Newsletter of Chemical Education,* No. 21, pp. 18-20.

Chimango, L.J. (1984): Opening Address Communication in Science Technology and Mathematics Education C.A.S.T.M.E Africa Regional Seminar, Malawi, 9-13 April 1984.

Collins G. (1982) Redefining the Role of Goroka Teachers’ College in the Continuing Professional Education of Teachers” (Mimeo).

Currie Report (1964). *Report on the Commission on Higher Education in Papua New Guinea,* Canberra, p. 156.

Deutrom, B. Minute of 17th September 1981, File EC2-3-l5 entitled ‘School Certificate Examination’ (Mimeograph).

Field, S. (1981). Generalist Teaching Policy and Practice, *Research Report No. 36* (Educational Research Unit, April 1981).

G.T.C. (1969). *Handbook, Goroka Teachers’s College*, Department of Education, T.P.N.G. (pp. 25-27).

G.T.C. (1970). *Handbook, Goroka Teacher’s College*, Department of Education, T.P.N.G (pp. 38-39).

G.T.C. (1972). *Handbook, Goroka Teachers College*, Department of Education, PNG, pp. 63-67.

G.T.C. (1984). *Handbook of Courses Goroka Teachers' College*, University of Papua New Guinea, Waigani, pp. 35-40.

Guthrie, G. (1983). An Evaluation of the Secondary Teacher Training System, *Report No. 44*, Education Research Unit, Port Moresby, PNG

Hayter J. (1982). The High School Mathematics Curriculum in Papua New Guinea: An Evaluation, *ERU Report No. 42,* UPNG, Nov. 1982)

H.M.S.O (1972). *Education: A Framework for Expansion,* Command 5174, pp. 4-9.

Husen, T. et al, (1978). Teacher Training arid Student Achievement in Less Developed Countries. *World Bank Staff Working Paper No. 310,* The World Bank, Washington: DC.

I.A.S.E.R. (1979). National Education Strategy (Chairman, C.A. Rogers), *Monograph 9*, Institute of Applied Social and Economic Research, Boroko, PNG.

Ilagi, G. (1980). National Strategies for Curriculum Development: Papua New Guinea, A.P.E.I.D. Regional Seminar, Canberra and Sydney, Australia, UNESCO.

Kappey, J. R. (1983). Linguistic Obstacles to Scientific analysis A Community Schools' Example, *Papua New Guinea Journal of Education*, Vol 19, No. 1, pp. 1-8.

Kirina W. & Sheret, N., (1975). *Secondary Science Teachers Guide: Form 2,* Department of Education; PNG (January)

Klassen F. (1982) Global Trends in Teacher Education, Education Today, (Journal of the College of Preceptors) Vol 32, No. 3, p. 5.

Kola, J.(1984) Science in P.N.G. and the future. Public Lecture UPNG, Waigani, 25 October, 1984 (Mimeograph).

Kola, J. (1985) Science and the big boys, *Chemistry in Papua New Guinea*,Vol 1, No. 3, August.

Lancy, D. F. (1979). Where have all the Students Gone?, *Education Research 1976 - 1979: Reports and Essays Ministry of Education Science and Culture*, Konedobu, PNG.

Larking, L. G. (1974). Some Difficulties in Improving the Quality of Teachers in Papua New Guinea in *Educational Perspectives in Papua New Guinea*, Melbourne, Australian College of Education, pp. 130-137.

Lornie, R. (1978). Teacher Training at Goroka, in *Secondary Teacher Training in PNG* ed Gerard Guthrie & Tony Wrightson, Goroka Teachers' College, Goroka.

Maddock, M.N. (1968). The Beginning of a New Era of Secondary Science Education, *PNG Journal of Education*, Vol. 5, No. 4, pp. 23-33.

Maddock, M.N. & Kirina, K.C. (1974). Science Curriculum Development and Evaluation in Papua New Guinea - The Evaluation of a Curriculum Development Model, *Research in Science Education,* Vol. 4, pp. 23-33.

McKinnon, K.R. (1976). Curriculum Development in Primary Education: the Papua New Guinea Experience in *Papua New Guinea Education* (Ed) E.B. Thomas, Melbourne, Australia, pp.49-56.

Murphy, T. (1983). Secondary School Subject Teacher Needs: Some Research by the Faculty Planning Committee, in *Papers Presented at a Meeting of Regional Secondary Inspectors and College Staff* held at Goroka. (Ed) W.P. Palmer and G. O'Hara, Goroka PNG.

Musgrove, P. W. (1974). Primary Schools, Teacher Training and Change: Beeby Reconsidered, *Papua New Guinea Journal of Education*, 10:1:42-47.

N.D.O.E, (1971). *Secondary Science Syllabus Forms 1-4*, Department of Education, T.P.N.G. (January).

170

N.D.O.E (1982). *Secondary Education in Papua New Guinea A Policy Hearing on Education III,* Ministry of Education, Waigani, PNG (October, 1982).

N.D.O.E. (1984). *Science Syllabus for Provincial High Schools*, Department of Education, PNG.

N.P.O. (1983). *The National Public Expenditure Plan 1984-1987*, National Planning Office, Waigani, November, 1983.

Palmer, W.P., (1984). New Teachers Look Back, (Mimeograph, revised version, 8.11 84), G.T.C., UPNG, pp.40-41.

Palmer, W.P. (1985). Beginning Secondary Teachers in PNG, Family Background, Choice of Subject and the Curriculum Needs of Schools, South Pacific Association for Teachers Education, Fifteenth Annual Conference, Hobart, Tasmania, Australia, July, 22-26, 1985.

Plowden Report (1966). *Children and their Primary Schools, A Report to the Central Advisory Council for Education Volume I*, H.M.S.O., UK.

Sheret, M. (1974). *Secondary Science Syllabus, Teachers Guide, Form I*, Department of Education, PNG (January).

Solon M. (1984). Where does the University College Leave Us? Seminar entitled Towards a Strategy for Higher Education in Papua New Guinea at U.P.N.G., Waigani (19 -21).

Tinsley H. (1977). Secondary Teacher Education in PNG, *The South Pacific Journal of Teacher Education*, Vol 5, No. 3, pp. 2l7-220.

Tinsley, H. & Davey H. (l977). Demand and Supply of Diplomate Teachers, Underway on a Five Year Plan (eds) J. Hanson, J. Agard, and P. Smith, *Fourth Extraordinary Meeting of the Faculty of Education.* (22—23 Sept,1977) Waigani, pp. 89-92.

A. Tololo (1977). Memorandum to Principal GTC of 4 Nov. 1977 entitled Specialisation in Maths & Science.

U.P.N.G. (1977). Background Papers for Submission to World Bank Goroka Teachers College, UPNG.

U.P.N.G. (1976). *Handbook of Courses*, The University of Papua New Guinea, Waigani, p. 302.

Weeks, S.G. and Guthrie, G. (1984). Papua New Guinea, Chapter in *Schooling in the Pacific Islands: Colonies in Transition* R. Murray Thomas and T. Neville Postlethwaite (eds) Pergamon Press, Oxford, U.K.

Wilson, M. (1978): Science Teachers in Papua New Guinea Schools, 1977, T.M.M.C. *Research Report No. 33*, Faculty of Education, UPNG, Waigani, June, 1978.

Wilson M. (1985). Teachers Views on grade 9 and grade 10 Science Units, Second International Science Study (5.1.5.5.) *Population II, School Report No. l* (mimeograph), July 1985.

Wilson, M and Wilson A. (1973). Science Teachers and Materials in Papua New Guinea High Schools. T.M.M.C. *Research Report No. 21*, Faculty of Education, U.P.N.G., Waigani, June 1973.

Wilson, M and Wilson A. (1981). Formal Operational Thought and Science Teaching in Papua New Guinea. *Papua New Guinea Journal of Education*, Vol. 17, No. 2, pp 187-199.

Yeboah-Amankwah, D. (1984). "Why Science in Papua New Guinea?". *Background Papers: The Role of Science and Technology in the in the Development of Papua New Guinea: The Policy Dimensions*, Ed J.R. Morton and M.G Aisi, UPNG Waigani September 3rd.

TABLE I (a): PROVINCIAL HIGH SCHOOL CURRICULUM IN SCIENCE COMPARED WITH GTC SCIENCE CURRICULUM (1960 - 1978: The Decline.

DATE	EVENT	PHS SCIENCE SYLLABUS	GTC SCIENCE SYLLABUS	REFERENCE
Prior to 1960	Virtually no secondary education			
1960's	P.H.S's started and secondary system expanded rapidly	Various syllabus used mainly overseas eg. Wyndham, Sarawak.		Maddock(1968)
1966		PNG Science syllabus introduced for Grade 7 & Grade 8.		N.D.O.E (1984)
1968	Secondary Teacher Training starts at GTC (a)	Grade 9 and Grade 10 Level Science syllabus produced. Quantitative & traditional(b) Almost immediate pressure to change syllabus (c).	3 year Science Course taught as 4 basic disciplines & method from Form Iv Grade 10. Quite complex physics required including relativity. Format of course seems to be major/minor (d), though elsewhere single subject specialisism is indicated (e).	(a) Solon (1984) (b) N.D.O.E(1984) (c) Maddock & Kirina (1974) (d) GTC (1969) (e) Lornie (1978)
1971	Presure for localisation of secondary teaching due to Self-Government & eventual Independence. Secondary system still expanding - Overseas teachers expensive.	Interim secondary science syllabus produced. Less traditional but still quantitative in apperance (a). Pressure for further change.	Handbooks(GTC) indicate change to less complex topics. Continous assessment of trainees now defined. Teachers teach two subjects (b),(c).	(a) N.D.O.E. (197 (b) GTC (1970) (c) GTC (1972)
1975	GTC became a part of UPNG (a)	New Grade 7 syllabus Jan.(1974) (c), New Grade 8 syllabus Jan. Similar to present syllabus. Significantly, more non - quantitative then earlier	Increasing numbers of Grade 12 students but still a handful (12 to 15). courses become 2 year from Grade 12, Grade 10 intake do PY year. 9 hours per subject.	(a) Tinsley (1977 (c) Field (1981) (c) Sheret (1974) (d) Kirina & Sheret (1975)

TABLE I (a) cont....

DATE	EVENT	PHS SCIENCE SYLLABUS	GTC SCIENCE SYLLABUS	REFERENCE
1975 cont.	Generalist Teaching G.T) introduced. A poorly planned educational failure (b)	GT brought pressure to simplify science syllabi further.	GTC introduced a third subject so that trainees received 6 hours per week of each subject over 2 years syllabi now vague about what was taught (e).	(e) UPNG 91976)
1977	Conversion course started: excess primary school teachers trained as secondary teachers. World Bank loan for expansion of GTC (a). However there was difficulty in filling places even before the expansion.	Continued revision of syllabi which continues to 1985.	28 Primary School teachers given a one year course to enable them to teach G. 7 and G.8 classes in PHS (b). Academic standards of these teachers were generally low but many had very effective methodology. GTC equipment up-graded.	(a) UPNG (1977) (b) Tinsley & Davy (1977)

TABLE I (b): PROVINCIAL HIGH SCHOOL CURRICULUM IN SCIENCE COMPARED WITH GTC SCIENCE CURRICULUM:

1979 to 1985: Slowly Up-Grading the Curriculum.

DATE	EVENT	PHS SCIENCE SYLLABUS	GTC SCIENCE SYLLABUS	REFERENCE
1979	A continued shortage of suitable candidates for teacher training	Continued syllabus revision to 1985.	GTC maths & cience department obtain permission to run two subject maths, science courses. Education Secretary approves (a). By 1980 all GTC courses in all subjects for new entrants were two subject courses with 9 hours per subject returning to the pre-1975 structure.	(a) Tololo(1977)
1982	Mid Year Rating Exam scrapped(a) Economic conditions become tighter, making secondary teaching a more attractive career.	Examination now in November to be based on content material of syllabus as well as understanding.	Two subject courses with 9 hours per week per subject now standard.	(a) Deutrom (1981)
1984	Education III Project (a)	PHS School system has expanded greatly both due to more schools and also blocking up to Grade 10 so that most students starting complete courses. New Grade 7 Syllabus	Attempt to introduce subject specialisation at GTC in Science called double subject Science (b) N.D.O.E threatened not to register trainnes. Course abandonned. (c, d) PY students decrease in number but 4 credits now required for admission.	(a) N.D.O.E. (1982) (b) GTC (1984) (c) Bunker & Palmer (1983) (d) Bunker (1984)
1985	Education III Project underway Includes A.D.U (b)	Science equipment to schools Grade 8 revised, but no further changes to syllabus contemplated until new PNG science textbooks are printed in 1986.	Major science/minor maths courses introduced in co-operation with N.D.O.E. (a) (16 hours science, 6 hours Maths). Course to start for existing science teachers in Schools from December 1985. It is called A.D.U Advanced Diploma.	(a) GTC (1985) (b) Collins (1982)