

THE DEVELOPMENT OF NEOCOLONIALISM IN PAPUA NEW GUINEA AND ITS IMPACT ON MATHEMATICS EDUCATION

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ABSTRACT

The history of mathematics education in Papua New Guinea began at least 40 000 years ago with evidence of scientific technologies from 10 000 years ago in agriculture, with earlier stone and pottery evidence. However, from the late 1880s, mathematics education was conducted by missionaries and then governments from colonizing countries. The impact of colonialism is summarized especially noting the significant impact of using English language and imported curricula or curricula ideas. Since Independence in 1975, neocolonialism continued to plague mathematics education impacting on social justice and meaningful mathematics education.

1 The significance of this study

Teachers require a knowledge of the history of mathematics education in their own countries in order to assess the merits of the curriculum that might be used in their country. Students from countries that have been (recently) colonised and immigrant students are particularly affected by curricula and education that do not take account of their home cultures and values. In rapidly changing countries, teachers often have a basic teacher education. Curricula are developed through overseas funding and experts and an upwardly mobile teaching profession working under political influences. The resulting neocolonial approaches might lead to a loss of cultural knowledge, values and well-being. Those with monetary wealth or not living in remote areas might be privileged.

2 Background

Papua New Guinea (PNG) had European settlers from the late 1800s with plantations, missions, and governments – in the north Germany and in the south Britain, substantially through its colony Queensland, and later Australia.

Schools in the north were for German and Chinese children in German but the missions also used vernacular languages, not necessarily the local language. The Lutheran Mission in Morobe chose a non-Austronesian language, Kôte, to facilitate learning and worship with mountain people. There are 850 languages in PNG and at least 103 languages in Morobe with more languages in the neighbouring mountains of Eastern Highlands and Madang where Kôte was used. In the south, Lawes, an early long-term missionary, wrote a Motu dictionary in 1886 and developed mathematics plans. After World War 1, the north became a Trust Territory of Australia (Paraide, Owens, Muke, Clarkson & Owens, 2023). Churches still use local languages.

In the first half of the 1900s, government funding was insufficient to run the colony and funds were only available to mission schools (most of the schools) if the schools taught in English and for the number of students who passed English and mathematics examinations set in Queensland (Smith, 1987). Mathematics was and still is valued as an examination subject to progress in school (Paraide et al., 2023).

Pioneering sociologist Mikloucho-Maclay (1975) in Madang, the Royal Cambridge Archaeological Society Expeditions, Malinowski (1917-1920) in the Trobriand Islands, and the Australians who were opening up new areas with administration centres recorded local practices and languages (Owens, Lean, with Paraide & Muke, 2018). Furthermore, there were two long-term Australian administrators, William Macgregor and Sir Hubert Murray, who were understanding in their decision-making (West, 1968). Schooling the ‘natives’ was to overcome exploitation by plantation owners and for pacification as there was not only trading between neighbours along trade routes but conflicts (Paraide et al., 2023).

These first contact references, teachers’ biographies, theses, research, and many government reports, curricula, and education publications, over 300 research reports of cultural practices, responses to questionnaires on counting systems (1000s) and measurement practices (352), in-depth interviews (25), field visits (25), oral histories (17) and our own lived experiences have made it possible to write a history of mathematics education, even before colonisation as many practices continue to today (Owens, 2015; Owens, et al., 2018; Paraide et al., 2023).

3 *Entrenching western mathematics education*

In the 1960s, the Prime Minister, Hasluck (1976) realised that the Papua and New Guinea Territories would be autonomous, and the government of Australia worked towards its independence. There was a hurried move to encourage education into high school and onto tertiary studies. Without university graduates, the country could not self-govern. Australian teachers were trained (many in a 6-month course in PNG) (Freestone, 2011), ready for the mushrooming primary schools with local teachers who watched and learned. Secondary education, staffed initially by Australians and other expatriates, began in towns. Teacher education courses began for Grade 10 graduates. Four National High Schools were set up to bring students from across the provinces together to reach Grade 12 and to learn to recognise and work across diverse cultures. The Universities provided Preliminary Years to recruit more students from Grade 10. Mathematics was taught at both the University of Papua New Guinea (UPNG) and PNG University of Technology (Unitech) providing graduates in all required areas. These Universities had outstanding professors and teaching staff from around the world who loved PNG and their competent students. Unitech soon had National Vice-Chancellors (3rd was Tigali, 5th was Moromoro, and 7th was Baloiloi). The Mathematics Department ensured support for all students to reach the high standard needed and tailored the courses for each degree. Eminent researchers in mathematics education such as Alan Bishop, Gilah Leder, Susan Pirie, Kath Hart, Ken Clements, and Beth Southwell visited its Mathematics Education Centre. The University went on to be an early user of computers for mathematics (Wilkins, 2000).

Before, and soon after Independence, school teachers used whatever textbook or curriculum could be found from overseas sources. Before Independence, the Administrator had even requested Zoltan Dienes (1999) to bring his multi-base arithmetic (MAB) and attribute blocks and introduce group activities for logical learning in mathematics. Teachers who had training found these useful techniques (Kirkby, 2019) but in most schools they were not known or used (Southwell, 1974). It might have seemed a good place to use MAB as the many languages vary in how they traditionally count. While most coastal and neighbouring languages use base 10 (35%), the majority of languages use other systems: 6, or 4, 8 (4%), some use one and two to form higher numbers (at least 10%), often with a body-tally system which might go to quite high numbers (e.g. 35) (16%), but many use cycles of 5 (47%) or (5, 20) (30%) di-

git tally systems (percentages approximate data in Owens et al., 2018). However, in any one place, there would be one (sometimes two) different systems except that in the islands different counting systems are used for different categories of items (Owens, et al., 2018).

4 *Independence and the Education System*

On 16 September, 1973, the country became self-governing. An all-PNG committee under Tololo, a highly respected educator, prepared an Education Plan which valued students' own cultures, encouraged respect, education for girls, and a basic education for all (Department of Education PNG, 1974). However, the expatriate Administrator could not see how it would be implemented and asked an expatriate Dean of Education at UPNG to prepare a plan that was implemented. Children started school at 7; Kindergarten had already been dismissed. The principles of the Tololo report were lost. This included recognition of language and culture. As some compensation, the primary schools were called Community Schools and teachers were encouraged to teach with community in mind, with community resources, and recognising that education needed to cater for village living. There was debate about whether to educate an elite or all children (Smith, 1987).

From a late start, by Independence, government departments were headed by nationals, universities produced graduates, and colleges produced teachers. Curriculum Officers prepared *Maths Our Way*. From 1975-1989, Papua New Guineans with one or two resident expatriates formed curriculum advisory teams for schools and teachers colleges (Paraide et al., 2023).

For school students, their goal is to achieve well in school mathematics and English for paid employment. The School Certificate and Higher School Certificate examinations kept a high international standard, although less relevant to PNG. The system was driven by examinations: Grades 6, 8, 10, 12. At each level there was a 50% push out rate with capable students unable to continue. Some of these continued with 'distance' education, often with a local tutor through a government or mission organisation (Paraide et al., 2023).

However, with external funding and pressure, overseas publishers produced mathematics books. Only Grade One of Community Schools Mathematics considered the local situation (e.g. PNG pictures without words for counting in the vernacular). In practice, mathematics was imported and linked to fur-

ther education. Later changes in curriculum were also accompanied by overseas produced textbooks.

Teachers guides and textbooks disappeared from the schools or never reached them. With curriculum documents, teachers learnt to write down the objective of the lesson, an introduction like “what do you know about ...”, some rote practice, a worked example, and exercises written on the board (usually just using numbers and algebra). Teaching as one was taught, predominately with rote learning, prevailed through generations. The authors were in school or teacher education throughout this period. This was confirmed by other teacher educators such as Kaleva. As part of our research we interviewed a group of PNG people living in Sydney (professionals, students, and residents) who were at school between the start and the end of this period, all noted that they had been forced to use English at school (punished if they did not). They said mathematics was primarily by rote without meaning. Too many times we heard “we have mathematics in school and mathematics out there; they are different and cannot be related”. For teachers and university graduates, there were years of schooling away from village and home language and, with high migration to the cities and a rise in the lingua franca Tok Pisin, there was language and culture loss (Paraide et al., 2023).

From the 1970s to 2020s, we were living through social change in the country, in the schools, and in teacher education. There were eight changes, three major – 1974 Community Schools with International Education Agency schools replacing T and A schools; 1986 with village elementary schools and Provincial and Secondary High Schools going to Year 12 with a Reform curricula, supported in 2001 by Curriculum Reform Implementation Project (CRIP); and 2014 with reversals of the Reform structure.

5 Ending colonisation: Recognition of the Voice¹ too late

Ten years after Independence, in 1986, the Matane report (National Department of Education PNG, 1986) reflected the Tololo report and the Reform and restructure of the school system began upholding the national 8-

¹ In Australia, the Voice became symbolic of giving First Nations peoples a Voice in their own affairs, and for others to listen. Here it is symbolic of Indigenous recognition in the face of neocolonialism and global pressures in mathematics education.

point plan for the nation (King, Lee, & Warakai, 1985). It aimed for universal education so village elementary schools were set up using the vernacular as language of instruction and for literacy. There were some successes (Paraide, 2003). Culture and girls' education were high on the agenda. However, the structural change was very disruptive and administration, already dispersed to the provinces, was difficult. There were elementary schools for Pre-Elementary, Elementary 1 and 2, then Grades 3-8 in Primary School, 9-10 in high school and most high schools offered Grades 11-12 with the best going to National High Schools or a provincial high school (Guy, 2009). Universities were insufficiently funded for 10 years in the 1990s, large lectures began, the support of the mathematics units at Unitech went, with loss of learning and discussion. The money was redirected to the primary or elementary schools but it did not reach them (Paraide et al., 2023).

There was a lack of teacher education for beginning learning which was supposed to be in vernacular in Elementary schools. Teachers often had large classes, were often unpaid, and had no facilities except a chalkboard, sticks and stones (Paraide et al., 2023). In the 1990s schools were issued with large shell picture books in which they could write the story in their own language for class reading. Summer Institute for Linguistics (SIL) provided many courses for teachers in how to select phonics to begin reading in vernacular, ready to transfer to English but this really gained impetus only after 2010.

The 10-year delay to the Matane report in introducing the values of the Tololo report was costly for culture and language and education. It was 15 years later in 2000 there were two large Australian Aid projects: CRIP which introduced Outcomes Based Education (OBE) and Primary and Secondary Teacher Education Project (PASTEP) (Howes et al., 2014), and later UK Volunteer Services Overseas (VSO) gave scripted lessons and phonics - more neocolonialism (Paraide et al., 2023).

Teacher education never achieved a compulsory ethnomathematics subject in teacher education even though its value was recognised in a couple of their mathematics lectures and the University of Goroka (UoG) had the Glen Lean Ethnomathematics Centre and a popular elective course called Mathematics, Language and Culture. PASTEP gave an elective to Teachers Colleges but it was not implemented due to financial and time pressures. For the critical home and culture beginnings of mathematical conceptualisation (Barwell, Clarkson, et al., 2016), the teacher training at the PNG Institute of Education

(PNGIE) did not incorporate ethnomathematics, mostly due to a turnover in staff and not having been introduced themselves to mathematics in that way. The school curriculum and support materials encouraged some ethnomathematics but teachers were struggling to implement the briefly worded OBE.

Our last design-research project (Kravia & Owens, 2014) on elementary school mathematics resulted in supplying the PNGIE with a Self-Instruction Unit (SIU) for Mathematics (Owens, Edmonds-Wathen, & Bino, 2015b) after trials with teachers (Edmonds-Wathen, Owens, Bino & Muke, 2018). We delivered 15 workshops in six coastal and highlands provinces, mostly in remote village areas with no services. Figure 1 presents a summary of the coverage. It introduced quality ethnomathematics teaching for beginning mathematics through inquiry, play, language, and cultural mathematics.

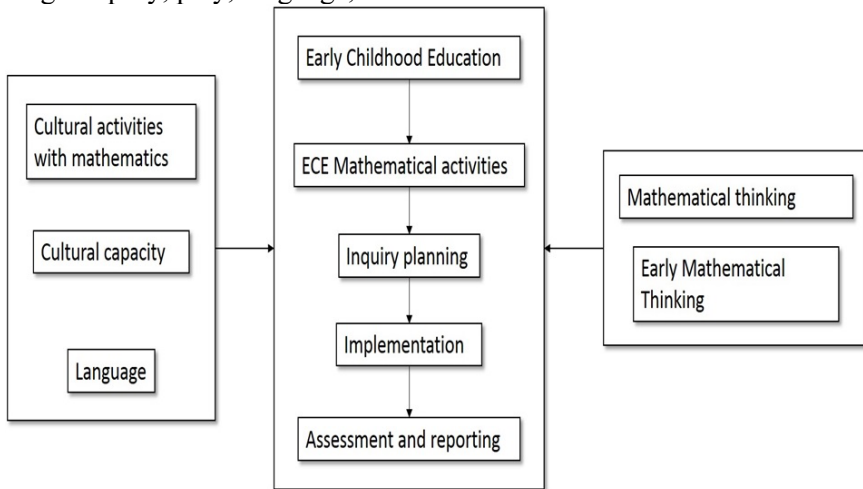


Figure 1. Early Childhood Mathematics.

The computer version was like a webpage and included the SIU with activities for teachers, a list of mathematical terms to be considered in local languages (Edmonds-Wathen, Owens, & Bino, 2019), materials which we used such as games, assessment tasks, early readers on topics like multiplication, area units, and composite unit of 10. It also had videos of cultural practices, teaching and assessment task. The workshop delivery included an introduction to computing so teachers could continue their learning. There were positive evaluations in all sessions and visits to schools indicated that teachers were implementing some of the key ideas such as encouraging more than one answer for an open-ended question, students talking more, and lessons incorpo-

rating cultural activities (Bino, Owens, Tau, Avosa, & Kull, 2014). However, the workshops were too short and needed follow up especially with the Prime Minister's 2014 decree that English was to be the language of instruction.

6 *Response to Reform Failure*

Papua New Guineans saw failure of the reform and blamed it on the use of home languages and OBE but the main reasons were lack of elementary teacher education; no cultural mathematics education; no multilingual or bridging/transition education; lack of funds for work on languages with the need for orthography and discussions with elders around language for mathematical ideas; messy restructure; and neocolonial curriculum designers (Paraide et al., 2023).

The call was to bring back English, and the new global approach was Standards Based Education. Many considered that standards across the nation meant English everywhere from the beginning of schooling even in remote villages where no one spoke English except, maybe, the teachers in the classroom. Some linguists (Temple, Dalsgaard, & Kamene, 2015) have correlated university students' success and age for starting to learn English, claiming that the malleability of the brain at a young age encourages learning of language. However, they barely acknowledge this variable, age for starting to learn English, was connected to socioeconomic status (SES) and lack of rurality. By contrast, a study in Morobe showed that learning sounds of the local languages (Tok Ples) assisted with reading and writing (Labuan, 2013) first in Tok Ples then English supporting Paraide's (2003) study. Furthermore, the literature on learning mathematical and other concepts suggests that students are more likely to learn these early concepts best in their home language and that learning them in another language soon afterwards would strengthen understanding (Barwell, Clarkson, & et al., 2016). Matang and Owens (2006, 2014) showed that students performed better on early mathematical concepts if they were taught in local language in Kôte but in other areas of the country those learning in English did as well but this sample included a school with university-staff children. One notable point is that students learnt less if Tok Pisin was used. This corroborated a study in which students were not learning to read and the worse ones were in schools where teachers were using Tok Ples, English and Tok Pisin. This study indicated the lack of training of teachers,

especially in bilingual education. A crisis was reached, languages were being lost too rapidly and teacher education was none or too little. The solution was to rewrite the curriculum without Tok Ples rather than funding the writing of orthographies, using inquiry learning based on culture or educating in bilingual learning.

Mathematics was supported by Japanese aid including a textbook, simplified and in English, that teachers could buy, avoiding reliance on government distribution. There is a lack of cultural examples, e.g. the symmetry example is tiles, found only in hotels and luxury apartments but many children live in self-help housing. There are many cultural examples that could be used.

There was another accompanying restructure: one year of kindergarten, six years of primary school and six years of secondary school. The majority of the elementary teachers were now out of work and needed primary education training. Another Australian project was set up but the very few PNG advisers keep saying “what about culture?” Enthusiasm, good intentions, and knowledge of the latest trends in mathematics education (not always the best) prevail in yet another neocolonial project. Overall, in education planning there has been no recognition that technology, science, mathematics (STEM) and folk lore are highly integrated in cultural societies, with visuospatial mathematical reasoning (Owens, 2015), understanding of the whole and infinity with traditional counting systems of many different kinds (not just base 10), and other vernacular mathematical language (Paraide et al., 2023).

7 Conclusion

Despite the recognition of the importance of language and culture for PNG identity and success in schools, and education for students in remote areas at Independence (Tololo Education Plan), the education system was built on Australian curricula and this continued for another 10 years before Matane led a further committee for change, reflecting the Tololo report. However, Australian Aid projects dominated the change and the World Bank recommended 3 years in the village schools using Tok Ples but this occurred without adequate teacher education or recognition of the needs of communities for language and literacy development and early bilingual education.

Ethnomathematics research in PNG is extensive: Matang (2006, 2014) and Kaleva (1998) and with teachers at UoG writing reports on their ethnomathe-

matics, Bishop (1988), Lean (1992) on counting systems, Clarkson, Muke, and Paraide on language over decades (see Paraide et al., 2023), and Owens and colleagues (e.g., Kaleva, Matang, Muke, Sondo, Edmonds-Wathen, Paraide, Bino, & Clarkson) between 1997 and 2023 (e.g., Owens, 2015; Owens et al., 2018; Owens, Edmonds-Wathen, & Bino 2015a). From pre-school to high school, it has been shown that ethnomathematics is relevant. Neocolonialism seems to have the stronger voice.

Neocolonialism and a failure of providing adequate teacher education for both bilingual and early childhood mathematics for the elementary schools has created an issue for PNG with cultural loss and disenfranchisement of some, particularly remote, students that may need to be addressed strongly from the grassroots as well as through government and academic policy.

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