RESEARCH TRAINING: A CASE STUDY IN INDONESIA

John CODD
transport consultant
(independent)
Scottish Borders - UK

1. INTRODUCTION

Long term collaborative research is undertaken by the UK's Transport and Road Research Laboratory (TRRL) and the Institute of Road Engineering (IRE), Indonesia. The TRRL collaboration is funded by the UK Government as part of its bilateral aid programme.

The aims of the research programmes are

- to develop transport infrastructure technology in Indonesia
- to transfer research capability to Indonesian counterpart staff.

Prior to 1988 the system of one-to-one TRRL researcher/ IRE counterpart had been adopted but was considered limited. The system of visiting expert paired with local counterpart is widely used in developed-developing country bilateral and multilateral technology projects. The limitations of this training system arise

- by the nature of one-to-one (ie not one-to-three for example)
- because limitations on the experts's time constrain the extent and depth of training possible
- because the expert may not be naturally endowed with or have otherwise acquired training skills
- because there is a conflict between the need to get on with the job and the need to stop and explain[1]
- because the expert may have lost some familiarity with the logical underpinning of aspects of his/her work.[2]

To make the benefits of the collaborative research

available to a larger number of IRE counterparts (called trainees hereinafter), and enhance the efficiency of the technology transfer exercise, IBRD funds were used to initiate a new Technical Assistance and Research Project (TARP).

The ten month project commenced in 1988. Two collaborative research projects involving on-the-job training were run in parallel with formal training in research methods. TRRL Overseas Unit supervised the project as a part of the continuing collaborative research programme. Project administration was managed by UK consulting engineers TP O'Sullivan and Partners, in a contract for consultancy services awarded by Bina Marga (the highways division of the Department of Public Works).

This paper reviews the formal training in research methods, the integration of on-the-job and formal training and problems encountered. Recommendations are made for the conduct of bilateral/multilateral research training projects and, by analogy, training components of technology projects in general.

2. PROJECT OBJECTIVES

The project terms of reference (ToR) stated the primary objective of the project: 'to improve the research capability of IRE to undertake research into subjects relevant to the construction, maintenance, operation and development of the Indonesian road network... the programme will include formal training in all aspects of research methodology as well as basic engineering topics'.

Behavioural training objectives were not stated. However, a wide variety of topics were suggested for possible inclusion. The topics ranged from the principles of the scientific method to scientific debate, from basic statistics to multiple regression, and included computer databases, spreadsheets, statistical analysis packages, literature search, technical report writing and oral presentation techniques.

The expectations and learning outcomes implied by the ToR were perhaps revealed by inclusion of topics such as 'scientific debate, assessing published work and planning research programmes'.

3. PRELIMINARIES

3.1 Criteria for trainee selection

IRE selected a pool of 30 potential trainee researchers. The selection took into account the relative needs and the likely future needs of the research divisions, the long term

need to develop promising young researchers and the ability of individual staff to benefit from the training.

3.2 The trainee group

The final size of the trainee group was limited to 20. This number was based on the availability of computer resources and the need for low staff/trainee ratios in tutorials.

The level of previous educational attainment of the trainees is shown in Table 1.

Table 1. Trainees by level of previous education

Number of trainees	Indonesian level of education	Comment
11	S1	Degree level
8	S0	Higher diploma level
1	SMT	Technical high school level

The educational background of the trainee group was much more varied than expected. Initial interviews with the trainees indicated that the mixed ability of the group would make it imperative to teach each subject from its beginnings since virtually no prior knowledge of the subject matter could be assumed. This in turn made the suggested syllabus content and depth look inappropriate within the time scale envisaged.

3.3 English Language (EL) capability

Initial interviews with the trainees revealed that English was a problem for most. To clarify the situation the British Council kindly arranged an abbreviated version of their Mini-Platform EL Test. The results for the twenty trainees are given in Table 2.

The EL test results indicated that only two of the nominated participants were likely to significantly benefit from the research training. It was advised that band three trainees could just about participate in the training but at a very minimal level of effectiveness. Trainee substitution was not a solution since the general EL capability of potential trainees was low.

Table 2: Summary results of English Language Mini-Platform Test

Band	Number of trainees	Full time EL training required
6 proficient	1	
5	-	
4 advised level for participation in training	1	
3	6	3 months minimum (normally 8)
2 false beginner[3]	6	6 months minimum
1 beginner	6	
TOTAL	20	

3.4 Project in crisis

To summarise the position - about two months after the start of the project the experts were mobilised, the research and training programmes were considerably developed and the trainees selected. However, general incompetence in English, lack of prior knowledge of subject matter and the mixed ability of the group meant that the project objectives were unachievable within the timescale available. Three options for dealing with the crisis were discussed:

- Option 1: the project should be completely reviewed and restructured
- Option 2: simultaneous translation should be introduced
- Option 3: the training should be delivered in English but adapted as far as possible to minimise sole reliance on English. This would be achieved as described in *teaching methods* below.

Option 3 was selected and had two sub-options:

- Option 3a: reduce the syllabus content indicated in the ToR to reflect the probable low rate of training progress possible.

- Option 3b: retain most of the syllabus content indicated in the ToR and accept that many of the trainees would not be able to keep up with the training programme.

Option 3a probably represented the most practicable way forward in the circumstances. However, another factor was taken into account.

It was by no means certain that the research training project would be extended or continued into a second stage. This made the possibility of reducing the training content undesirable since IRE could be left in the position of having researchers half way through a training never to be completed.

On the other hand if a fairly complete and stand alone unit of training was delivered then, even though many trainees would fall behind, there would still be the possibility for IRE to train internally. Researchers could subsequently be brought up to the required standard. Such an internal *regeneration* would draw on course material developed, IRE and ITB (Institute of Technology, Bandung) staff involved in the initial training and the trainees who *survived* the training programme.

Thus, it was agreed to continue with the project, largely as indicated by the ToR (Option 3b), but to implement as many EL amelioration measures as possible. The training would be targeted at the band three EL capability level and although IRE management preferred to leave trainees scoring below band three within the training programme it would have to be accepted that many would not be able to keep up.

3.5 Co-ordination between formal and on-the-job training

Initially seven on-the-job training positions were identified by experts working in the two TARP research projects. This number was less than originally envisaged.

The trainees involved with the TARP research projects were required to spend considerable amounts of time on site collecting data. In particular the three trainees involved with one of the research projects spent large periods of time away from base. It became impossible to coordinate a formal training programme involving these trainees. Thus the training timetable focused on the four trainees involved with the second research project.

The aim of widespread participation in formal and on-the-job training could not be met.

4. THE FORMAL RESEARCH TRAINING PROGRAMME

4.1 Achieving the training objectives

Within the general aim of improving research practice the topics suggested in the ToR were formed into three main subjects: Research Methods (30 hours), Applied Statistics (90 hours) and Computer Studies (70 hours). Other activities (40 hours) were also arranged and including a series of three colloquia on themes related to the collaborative research projects. The course was fully documented for IRE's continuing use at the end of the project.

The cognitive levels are commonly taken as a hierarchy ascending from knowledge, through comprehension, application, analysis and evaluation to synthesis (ref 1). The levels of development within each syllabus are given in Table 3.

Table 3: Cognitive development within syllabi of main subjects

Module	Cognitive Level
Research Methods	Knowledge, Comprehension
Applied Statistics	Knowledge, Comprehension, Application and Analysis
Computer Studies	Knowledge, Comprehension and Application

4.2 Teaching methods

The following measures were implemented to ameliorate the lack of EL capability within the trainee group:

- comprehensive handouts in relatively simple English were prepared
- lectures and handouts were identical
- during lectures handouts were always visible on the overhead projector screen
- key topics and examples were re-explained in Bahasa Indonesia, by senior IRE researchers who acted as tutorial assistants and technical translators
- whenever possible handouts relied on mathematical notation rather than English
- tutorials were bilingual.

5. TRAINEE ASSESSMENT

5.1 Assessment results

Written examinations were used to assess trainee performance. A practical examination was used in the case of computer studies. The examinations were moderated and the results are shown in Table 4.

Table 4: Final examination results (main subjects)

	Research Methods (per cent)	Applied Statistics (per cent)	Computer Studies (per cent)
Mean	36	33	54
Standard Deviation	8	12	26

The examinations were set to a strict standard, known to be higher than the trainees could perform well in, in order to realistically assess the performance of trainees relative to a competent standard for IRE research. Although there was no pass mark as such, any mark over 40 per cent was deemed to be satisfactory.

Out of the original 20 trainees six were lost due to natural wastage. Out of the 14 remaining trainees five performed satisfactorily or better in all subjects; two were outstanding.

5.2 Before and after tests

Before and after tests were conducted in Research Methods and Applied Statistics. The results are shown in Table 5.

Table 5: Results of *before* and *after* tests (per cent)

Statistic	Research Methods		Applied Stats.	
	Before	*After*	*Before*	*After*
Mean	10	58	9	24
Standard Deviation	12	23	6	14

The *after* scores are significantly greater than the *before* scores. Since the Applied Statistics test was fairly *tough*, a true indication of overall improvement probably lies between the two assessed percentage improvements. An improvement, although limited, had been achieved.

6. EVALUATION OF TRAINING

6.1 Analysis of trainee assessment

With the exception of a weak association between *before* Research Methods results and EL scores[4] (see Table 6 below) the *before* test results and EL scores were random. However, the *after* test scores, shown in figure 1, show a stronger association, with trainees tending to score high in both subjects or low in both subjects. There is a high and a low scoring cluster of data points. The higher scoring cluster relates to trainees in EL bands three and above, whereas the lower scoring cluster relates to EL bands one and two.

Correlations between EL test scores and the *before* and *after* test results are shown in Table 6.

Table 6: Correlations between EL test scores and *before* and *after* test scores in Research Methods and Statistics[4]

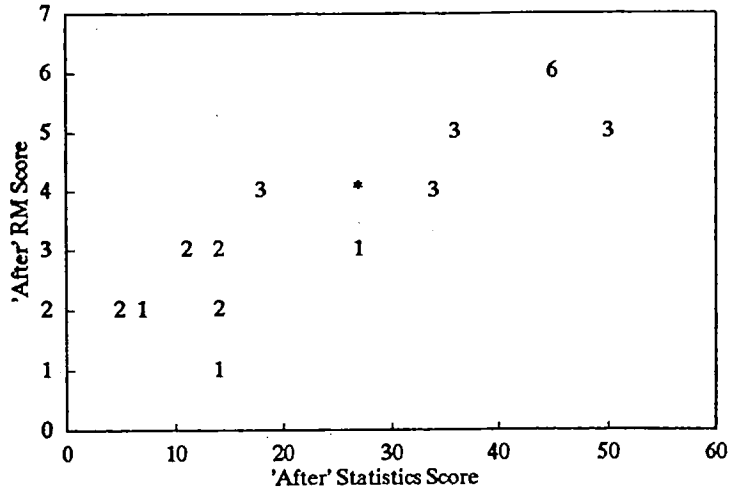
Test	*Before*	*After*
Research Methods	0.43	0.84
Applied Statistics	-0.03	0.68

In general the results of the *before* and *after* tests would support the hypothesis that improvements were related to the initial EL capability.

The association between measures of trainee performance and initial EL capability is further confirmed by the final assessment results. The association is shown in the scatter diagram in figure 2. The data point labels show previous attainment of a numerate degree and the clusters suggest that the training was suitable for those trainees having successfully completed numerate degree courses (Indonesian S1 level courses in engineering, physics etc). The data suggests that prior attainment of a numerate degree is as important if not more important than the initial EL capability.[5] The data supports the proposition that the mixed ability of the group gave rise to a teaching/learning problem and supports the contention that project expectations and the mixed ability of the training group were incompatible.

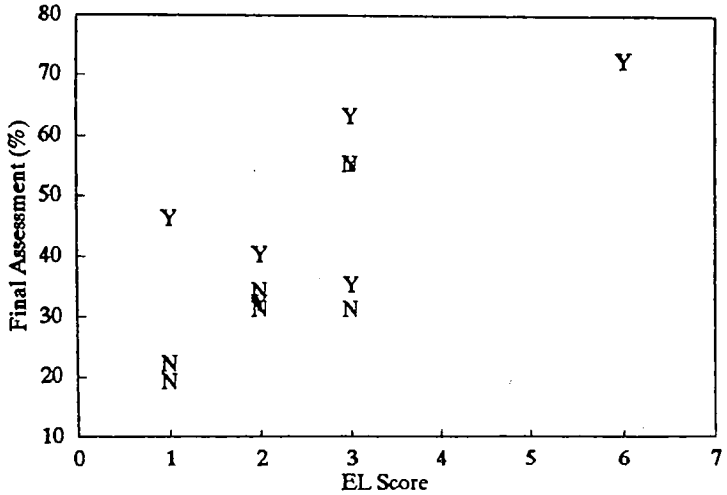
6.2 Recommendations for further formal research training

A programme of further training was recommended. In brief this involved EL training, training in basic engineering subjects, a special remedial module for the nine *less than satisfactory* trainees, the repeat of a *streamlined* research



Data labels are EL test scores
Correlation coefficient = 0.87

Figure 1 Trainee assessment: *after* scores



Data labels indicate previous educational attainment:
Numerate degree = Y, Other = N. Correlation coefficient = 0.76

Figure 2 Association between final assessment score, English Language (EL) score and previous educational attainment

training and more...

There was a danger that the progress made by trainees yet to attain a satisfactory level of performance would be dissipated if there were no prompt follow up. The rate of learning and increased understanding towards the end of the training period was marked. The remedial module was thus required as a matter of urgency. Unfortunately funding mechanisms to take advantage of this situation did not exist and the timeliness for further immediate inputs was lost. In fact, the remedial module (and other training) took several years to materialise.

7. DISCUSSION

The story of the formal research training component of the project could be explained in terms related to over-ambitious expectations, deficiencies in project preparation and resultant underestimation of time required to achieve expectations.

Equally the story could be explained in terms of project structure and funding arrangements. The need to meet contractual obligations specified in the ToR and the uncertainty regarding IBRD's commitment to fund further research training at IRE both influenced on-the-spot decisions and direction taken at the point of crisis early in the project. A more flexible contractual arrangement would probably have assisted project implementation but in the final analysis greater long term funding security is probably the key element that would have resulted in revised short term training objectives once the initial problems were revealed.

The overall requirement is to bring about real and long lasting but probably small step-by-step improvements in research capability.

8. CONCLUSIONS

1. There appears to have been a distinct lack of project preparation in relation to training. A project preparation mission could have averted most if not all of the training problems encountered in TARP. An appraisal mission would probably have advised project postponement until after EL training.

2. The improvement of IRE research capability to the point of sustained quality R&D output is essentially a long term objective which requires a long term funding commitment.

3. Assessments of trainee performance were associated with initial English Language (EL) capability and prior attainment of a numerate degree.[5]

4. The momentum of the research training was lost at the point TARP ended. A facility to follow up the training with remedial tuition and supervised application of new techniques could have been very cost effective. Again, the prior provision for follow-up is a matter for project preparation.

5. Intensive demands of the research projects and formal training programme made it impossible to coordinate an effective timetable for combined on-the-job and formal training. In the event only four individuals benefitted from the combined training. The *raison d'etre* of the project was lost. This problem could have been foreseen if timetable feasibility had been investigated as a part of project preparation. Once again, this points to the need to include training and curriculum development expertise at an early stage of project planning.

6. Given a long term funding commitment it is likely that, after project preparation and resultant EL testing, a training expert would have recommended a simpler training approach, but over a longer time scale, for example

Year 1:	EL training (and other preparatory training if required)
Year 2:	Formal research training (day release)
Year 3:	Practical on-the-job training related to formal training, tutoring/supervision by formal training and research project experts (plus remedial research training if required).

In the light of experience gained in TARP it would now be advisable to add a possible fourth year:

Year 4:	Flexible follow up to be designed if and as required.

9. RECOMMENDATIONS (FOR SIMILAR PROJECTS)

1. It is essential that project preparation should include a thorough treatment of the training elements. This should be carried out by training/curriculum development experts.

2. Training objectives, trainee selection and entry level capability, the training period and training resources must be carefully matched at the project preparation stage.

3. Entry to research training programmes should be closely controlled, using entry tests in circumstances of uncertainty.

4. Technology transfer projects with formal training elements could generally benefit from *before* and *after* modules. The *before* module should be associated with project preparation and include provisional selection of trainees, entry testing as appropriate and timetable feasibility. If required, pre-project language and other entry level training should be specified and carried out at this stage. The *after* module should at the project preparation stage loosely define follow up training activities, some of which would be remedial in nature. These activities should be elaborated (or even redefined) towards the end of the main project.

NOTES

1. The achievement of project objectives is visible in terms of data collected, testing, analysis and reporting. The counterpart's training is less visible and may not have priority when time or other resource conflicts occur.

2. Such familiarity may not be necessary for day to day practice but is often important for cognitive development and learning without frustration.

3. False beginner refers to candidates who may have had some EL training already but who are still confused and are effectively beginners.

4. The tests were in English. The statistics test used mathematical symbols wherever possible. This could explain the fairly large difference between the two *before* correlations.

5. There was no evidence to support the hypothesis of association between EL capability and the prior attainment of a numerate degree.

ACKNOWLEDGEMENTS

Constant encouragement and support from the late David Brooks, TRRL Overseas Unit, and Ir Soedarmanto, Director of IRE.

REFERENCE

Taxonomy of Educational Objectives. Book 1: Cognitive Domain. BS Bloom [ed.]. London: Longman, 1956.