

B.E.S.T. (Building Effective Strategies for Teaching) of Science: An Exploration into the Culture of Collaboration

Dr Lourdes M Ferrer

Universiti Brunei Darussalam
Bandar Seri Begawan 2028
Negara Brunei Darussalam

Introduction

In 1994, the Ministry of Education (MOE), Brunei launched a programme for the training of specialist teachers in primary science and mathematics. Since the university plays a vital role in helping teachers acquire and expand their professional knowledge and skills, Universiti Brunei Darussalam (UBD) collaborated with MOE in running courses in content and methodology. A total of 54 teachers from 12 participating schools attended a three-week training course for the purpose of enhancing their subject matter content knowledge, pedagogical content knowledge and pedagogical reasoning in primary science and mathematics. This course is typical of the structured course for inservice education cited by Ellerton (1996).

To find out if the inputs gained from the intensive course are actually used in teaching, a monitoring team composed of 17 education officers, researchers and teacher educators was set up by MOE to observe the project teachers. Based on the initial feedback of results, inadequacy in pedagogical content knowledge still existed. The teachers were so engrossed in covering content through transmission teaching. This finding concurs with a number of major studies of science classrooms cited by Hand and Treagust (1995). Their studies show that teachers usually focus instruction on rote learning of facts and algorithms which Hand and Treagust call decontextualised content knowledge. Most of the teachers' content knowledge of the subject which they impart to children is not related to the context within which the knowledge is constructed. This is one difficulty identified which aggravates the pedagogical content knowledge problem. Pedagogical reasoning was not at all manifested by the teachers. Their classroom decisions were always based on the need to cover the syllabus rather than the need to make children uncover the concepts through hands-on/minds-on activities.

The results of the inservice course indicated a need to revise or change the model of professional development embarked in the earlier phase of the Specialist Teachers Project. In consideration for a new model, the criteria set by Owen, et al. (1988) were used to choose the best framework for the Bruneian situations. According to them, a good

professional development model should:

- address issues of concern recognised by the teachers themselves
- take place as close as possible to the teachers' own working environment
- take place over an extended period of time
- have the support of both colleagues and the school administration
- provide opportunities for reflection and feedback
- enable participating teachers to feel a substantial degree of ownership
- involve a conscious commitment on the part of the teacher
- involve groups of teachers rather than individuals from a school
- use the services of a consultant/or critical friend

A Constructivist Approach to Teacher Change

An important point to consider in any teacher development programme is the approach to be used in effecting teacher change. In the old paradigm, change is mandated by policy makers or curriculum reformers. The teacher, through an irresistible external pressure, carries out the mandate in the classroom without commitment. In the new paradigm according to Weissglass (1994), change occurs as the result of complicated interactions among people. This kind of change requires personal transformation and improved collegial relationships. The constructivist approach is viewed to possess the necessary ingredients to effect this kind of teacher change.

Professional development programmes informed by constructivism focus on collaborative endeavours where teachers work with peers, researchers and teacher educators in negotiating meanings in the process of knowledge generation (Ferrer and Leong, 1996) and where teachers, along with leaders and students share and provide mutual assistance (Yager, 1991). There is also a sense in which constructivism implies caring - caring for ideas, personal theories, self-image, human development, professional esteem, people - it is not a take-it or leave-it epistemology (Watts, 1994).

The Study

Purpose

The purpose of this study is to explore the culture of collaboration which is an important component of constructivism. Of particular concern is the growing interest for collaborative reflection. Within this perspective, opportunities for working together are required to enable teachers to share and listen to each others' views. These opportunities create an interesting arena for exploring of teachers' problems and how they can work together to solve these problems.

The study specifically seeks to find out if the strategies collaboratively worked out can bring about improved pupil achievement. It also endeavours to investigate the changes that teachers make as a result of interactions and collaborative reflections.

Subjects

Collaborative reflection was adopted as a technique with a group of 17 science teachers from 12 primary schools in Brunei-Muara District whose particular interest is the improvement of their pupils' examination results through building effective strategies for teaching. Thus, BEST emerged out of this concern.

Methodology

BEST of science necessitated a structure that permits on-going collaboration between teachers and academics. To optimise the potential of such collaboration, five conditions set by Mitchell (1995) were observed. These are:

All members of the group should be seen as equal in status though offering different expertise.

At least one teacher in the group should provide leadership.

Personal contact is more effective than documents for presenting new ideas.

All participants should have some sense of their roles.

The emphasis should be more on the problem and less on the procedure. Ownership, and hence flexible use, is more likely if the procedure is regarded as being a trial procedure.

All five conditions were followed in carrying out the following activities:

1. Teachers' Workshops and Classroom Practicals

Regular school-based monthly workshops addressing issues of concern by the teachers were conducted with 17 science teachers playing active roles as discussion leaders on rotation basis. Members of the monitoring team who take the role of critical friends interact with them during the discussion.

The initial workshops focused on exploring teachers' understanding of an effective science teacher. Using as base the criteria that ensued

out of the discussion of an effective teacher of science, the teachers were asked to critique some video lessons showing different classroom practices. The teachers were divided into smaller groups and each group asked to suggest ways of making the teaching shown on video more effective. The objective was to make them work collaboratively in developing teaching strategies that they can truly call their own.

The teachers were encouraged to try out the new found strategies in their own classrooms and asked to keep records of results to be discussed in the next workshop sessions.

The subsequent workshops focused on their most pressing need which was identified in a needs-assessment workshop with them. The need to perform well in public exams was brought up. A major cause of poor performance was children's difficulty in understanding certain concepts in science. To address this problem, the teachers were divided into grade level groups representing primary 4, primary 5 and primary 6. Each group identified specific subject matter areas where children experienced conceptual difficulty. They also discussed the causes of these difficulties.

The following workshops were conducted to determine where the children are with respect to areas of concern. A diagnostic test was collaboratively developed by the teachers to determine the conceptual understanding of the children in the identified area of concern. The test was administered in their classes and the results discussed in the next workshops.

The different strategies suggested by the teachers were tried out in their classes. Evaluation of effectiveness of these strategies was done through the use of a parallel form of the diagnostic test, this time administered as posttest. The table below shows the results obtained before and after the introduction of the treatment variable which was the intervention strategy implemented in class.

Table 1: Pupils' Performance in the Teacher-Made Test

TOPICS	SKILLS	Percent Correct	
		1st Admin	2nd Admin
Parts Uses of Plants	ident, naming/list	48	62
Animal Classif	comparg/contrast/classif	40	57
Waste Disposal	describing, applying	28	30
Drugs	identifying	26	30
Infectious Dis	descr, classif(mode of transf)	30	39

The substantial increments for the first two topics may be attributed to the teaching strategies employed. Obviously for the last three topics, the interventions used did not work well to produce significant improvements. The situation required further probing through observations.

2. Classroom Observations and Critical Analysis

The idea of classroom observation was not welcomed at first so it was shelved until such time the teachers indicated readiness for it. In one of the group activities with teachers, the need for feedback of results from the tryout of strategies was raised. It was pointed out that it is not enough to get information from the teachers who tried them out. The need for feedback by critical friends became apparent. In the new perspective the teachers viewed observation by their critical friends as support mechanism to evaluate further the effectiveness of strategies used. The observation focused on the kind of learning environment created as a result of strategy implementation. The graph on the next page shows the overall initial results of observations made with 17 science teachers. This was presented to the teachers for their critical analysis.

Figure 1: Classroom Environment Observation Results

(max score = 5)

Pe -Personalisation, Pa -Participation, Iv -Investigation, Di
-Differentiation

(Based on Fraser's Classroom Environment Questionnaire)

The results indicate that teacher personalisation as well as pupil participation and differentiation need to be improved. This requires the adoption of a new pedagogy and change in one's pedagogical knowledge. The teachers had to develop a pedagogical knowledge that involves the use of negotiation and group work (Prawat, 1990) as well as differentiated activities. The very essence of collaborative work they do in the workshops and how the process of reflection-on-action has changed their conception was brought forth in developing a new pedagogy in working with children. To be able to use effectively the collaborative process as part of the pedagogy it is necessary to experience it first.

Experience is crucial to the way teachers work with children. Their experiences in collaborative reflection were used to develop classroom approaches that enhance personalisation, pupil participation and

differentiation. These approaches emphasise working in groups for pupils to share experiences and ideas, help each other in interacting with materials, and construct knowledge collaboratively, and also working individually at own pace in doing the seatwork exercises given at the end of the lesson.

Group work affords many opportunities for transforming classrooms into active learning environments where pupils investigate problems raised and take responsibility for learning ways to solve problems while collaborating. If group work is to be effective, Kempa and Ayob (1991) assert that the participants in it need to be able to manage their activities. To enable this to happen, the teachers stressed four points in carrying out science activities.

Each group member should assume specific responsibility and cooperate with one another.

The more able pupils in a group should extend support to the slow learners through peer tutoring.

Everyone should be on task and sharing ideas with others.

Should differences crop up, negotiation should be the driving force to bring back the spirit of teamwork.

The technique of negotiation was identified as powerful tool in improving the personalisation aspect of teaching. This technique involves talking with individual pupils who have manifested misconceptions in learning and encouraging them (without pressure) to move towards adopting the scientific point of view as their own.

In keeping with the emphasis on negotiation, group work and differentiated learning as strategies that are meant to enhance personalisation, pupil participation and differentiation, the teachers were asked to try out different ways by which these strategies can be carried out. They were asked to critically analyse the results of their own tryout and be prepared to share their findings.

In addition to the over-all graph of results presented, individual graphs were distributed to the teachers. They were encouraged to reflect on the results and critically examine specific areas that need improvement in their own teaching.

3. Documentation

Heaton (1992) contends that while collaborative conversations serve as a stimulus for change, they are, by themselves, not enough to promote teacher's learning. Experience and reflection are also essential.

Implementation of new practices in the classroom and feedback in terms of how they affect pupils' learning constitute experience which needs to be documented. This document provides a springboard on which to base one's reflection.

Initially, diary writing was a required activity for the teachers to document significant events in their teaching. It was also meant to guide individual reflection and enhance their critical analysis. These intentions, however, were not realised. Since the teachers have not developed the habit of sustained writing to record important episodes in their life as teachers, this activity did not produce the desired results. Their writing was a little more than lists of events, broadly stated, and often carried judgmental statements of affect. The teachers wanted some sort of guide on which to build their thoughts. Thus, worksheets were developed for them. These worksheets served as guide for reflective writing.

To encourage more writing, the teachers were asked to document successful teaching experiences for BEST (Building Effective

Strategies for Teaching) Bulletin. This publication was set up jointly by UBD and MOE for the project teachers who have something to contribute to a larger audience. The BEST Bulletin has created an avenue for disseminating accounts of classroom experiences to other teachers.

Findings

Observation Results

Classroom observations revealed three stages of interest manifested by the teachers. They are the ACT (Awareness, Consensus and Transformation) concerned with the evolving development within the teacher which determines the role that will eventually be played by him or her in the classroom.

Many of the teachers manifested interest in working with the pupils through group interaction and arriving at meanings through negotiation.

This is the second stage of interest that is comparable with Grundy's (1987) practical interest in which the basic orientation of the teacher is towards making children understand the environment through teacher-pupil interaction that is based on a consensual interpretation of meaning. This interaction was evident in group work and class discussions. Pupil-pupil interaction encouraged by the teachers was also demonstrated in group work. More pupil participation through group work was carried out by 53 % of the teachers compared with a low 35 % of last year. They were observed by 26 preservice teachers who used the same instrument with the project teachers in the

first phase of the study. Some of the comments made by the observers are shown below.

Pupils are not shy to ask questions.
Everybody participates, both in talk and non-talk activities.
The bright ones act as little teachers.
There is more pupil talk as children work in groups.

Some teachers were left behind in the awareness stage, which Grundy calls technical interest. Hand and Treagust (1995) describe this level as fundamental interest in controlling pupil learning through rule following action. Although the teachers were fully aware of the benefits that are derived from strategies informed by constructivism, some of their applications in the classrooms still revealed the teachers' concerns for their own adequacy in class and class control. The observers' reports shown below attest to these findings.

All pupils do the same work at the same time.
All pupils use the same worksheets.
The fast learners are not given activities to work on after they have finished their tasks.

Four out of 17 teachers, or 24% obtained very low rating in the component of differentiation in the learning environment instrument. This component refers to the selective treatment of pupils on the basis of ability, learning style, interest and rate of working (Fraser, 1995).

No one has reached the transformation stage which is similar to the emancipatory interest of Grundy. Transformation stage is concerned with interest in autonomous action arising out of critical insights from individual reflection and collaborative reflection-on-action. A teacher in this stage can be described as an extended reflective

professional (McKernan, 1992); one who has an inquiring attitude to the profession and to personal performance, and a broad understanding of curriculum.

Interview Results

Unstructured interviews were conducted to get feedback of what the teachers feel about the project in its second year of implementation. Interview questions were directed to activities they like doing and those they find difficult to carry out.

The school-based workshops where teachers talk and listen to each other have built up their confidence. All the teachers acknowledged this benefit. Through working in groups the teachers discovered that they have something important to contribute and that their ideas can be

useful to others. By engaging in collaborative building of effective strategies for teaching, most of the teachers realised that there isn't just one way of solving problems of learning.

The activities on knowing their pupils through diagnostic testing and discussion of classroom problems with peers were very enlightening to many of them. As a result of immersion into the process of knowing their pupils, they find themselves now as more understanding of their children's understandings, more facilitative than directive in their roles and more appreciative of the value of collaborative work than before.

They now see collaborative work in class as an avenue for enhancing children's learning ability to construct knowledge. Working in groups, according to most of the teachers interviewed, gives their pupils time to think and share their thoughts with others in the most comfortable way without taking the risk of being wrong in front of the entire class. They say that the whole process is a boost to the pupils' self confidence. The teachers are all aware of these benefits because they have experienced them in their own collaborative work with co-teachers.

The teachers differentiated clearly between conventional observation and the kind of observation that emerged out of the collaborative process they embarked on. Many say that the power-based situation in conventional observations by inspectors pointing to them what had gone wrong and telling them that it should have been done this way turns them off. The observations in the current professional development programme were well accepted because they were focused on strategies collaboratively developed by the teachers themselves and being tested in the classrooms by them.

Some teachers expressed writing of reflections, minutes of the meeting, accounts of successful classroom experiences as a difficult task to perform, especially if the medium of communication is English. It was hard for them to generate ideas required for the kind of reflection that would lead them to a reconstruction of the teacher act.

Achievement Results

The presence or absence of improvement in achievement results is influenced by classroom learning and pupil aptitudes. The quality of pupil learning in the classroom is dependent upon instructional processes and to some extent, pupil aptitudes. Instructional processes include classroom interventions employed by teachers in addressing

conceptual difficulties of their pupils and classroom environment to

support learning.

The effect of instructional processes was strongly felt in the 1995 PCE results. Seven out of 12 schools had primary six science teachers whose pupils took the 1995 PCE (Primary Certificate of Education) examination. All the schools except one had substantial improvements in terms of increasing the number of As and Bs and decreasing cases of Fs in the achievement test results of the pupils. Comparison of the 1995 performance was made with the school's performances for the last four years.

Conclusion

Follow-up activities after the initial training through the usual structured course for inservice education are mandatory.

Follow-up observation and assessment proved helpful in enhancing reflection. By providing the teachers with immediate feedback of observation results especially those that are found to be related to pupils' learning problems, the teachers were able to focus their attention on these problems, reflect on them and critically analyse their practice related to the problem.

The workshops have encouraged collegiality among the teachers and downplayed isolationism in the profession. Through dialogues and collegial interactions during the workshops, several levels of pedagogical knowledge, values and appreciation emerged.

Collaborative inquiry through classroom practicals have increased opportunities for teachers to work with children more closely. In the process, they have come to understand how children learn and how they can be assisted to learn more effectively.

The documentation activities have, in one way or another, helped the teachers communicate their thoughts in writing. Through the use of worksheets, teachers have come to describe what they do, how their pupils react, and what problems they encounter in teaching.

Of these follow-up activities, the workshops and classroom practicals were most preferred. The culture of collaboration built within each of these professional development activities has turned teachers into reflective practitioners working together cooperatively and creatively in building effective strategies for teaching.

References

Ellerton, N. (1996). Professionalism and the ownership of inservice teacher education. Paper presented at the National Colloquium Towards Developing and Strengthening Partnerships in Teacher Education,

Universiti Brunei Darussalam.

Ferrer, L.M. & Leong Y.P. (1996). A constructivist approach to teacher change, (Technical Report No.1). Brunei: MOE-UBD Publication.

Fraser, B. & Wubbels, T. (1995). Classroom learning environments. Improving Science Education. USA: NSSE.

Grundy, S. (1987). Curriculum: product or praxis. London: The Falmer Press.

Hand, B. & Treagust, D. (1995). Development of a constructivist model for teacher inservice. Australian Journal of Teacher Education, 20 (2).

Heaton, R. (1992). Who is minding the mathematics content? A case study of a fifth-grade teacher. Elementary School Journal, 93.

Kempa, R.F. & Ayob, A. (1991). Learning interactions in group work in science. International Journal of Science Education, 13 (3).

McKernan, J. (1991). Curriculum Action Research. London: Kogan Page Limited.

Mitchell, I. (1995). Sustaining support and stimulation: The teacher group 1986-9, In J.R. Baird & J.R. Northfield (Eds). Learning from the PEEL Experience. Melbourne: PEEL Publications, Monash University.

Owen, J., Johnson, N., Clark, D., Lovitt, C. & Morony, W. (1988). MCTP professional development package: Guidelines for consultants and leaders. Canberra: Curriculum Development Centre.

Prawat, R.S. (1990). Changing schools by changing teachers' beliefs about teaching and learning. Elementary Subjects Centre, Michigan State University (19).

Watts, M. (1994). Constructivism, reconstructivism and task-oriented problem-solving. The Contents of Science: Constructivist Approach to Its Teaching and Learning. London: The Falmer Press.

Weissglass, J. (1994). Changing mathematics teaching means changing ourselves: The implications for professional development. Professional Development for Teachers of Mathematics. Virginia: The National Council of Teachers of Mathematics, Inc.

Yager, R. (1991). The constructivist learning model: Towards real reform in science education. The Science Teacher.



Paper Presented at the Joint ERA/
AARE Conference, Singapore, 1996