1995

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DEVELOPMENT OF A CONSTRUCTIVIST MODEL FOR TEACHER INSERVICE

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INTRODUCTION

In this paper, we consider a model for teacher inservice that is informed by constructivism. Initially, we consider the criteria for identifying conceptual change, briefly examine research on the roles which teachers engage in when implementing innovations, and describe the different knowledge bases needed in using teaching approaches informed by constructivist referents. Secondly, we describe an inservice programme for science teachers in one high school, and thirdly show how a five-stage model to introduce teaching/learning approaches informed by constructivism was developed.

Approaches to teaching and learning which are informed by constructivism focus on the learner's conceptual knowledge because in constructing knowledge each learner's conceptual framework will change. A model of conceptual change developed by Posner, Strike, Hewson and Gertzog (1982) has received wide currency in science education circles and has been used in teacher education. For example, Baird and Mitchell (1986) used the conceptual change model to explain teacher change resulting from an extended inservice programme to promote effective learning in the classroom, and Gunstone and Northfield (1988, p. 1) adapted the model for describing teacher change because "constructivism and conceptual change need to be considered in the same way for students, teachers, and researchers." Tobin (1993) has suggested that, in the process of encouraging changes in teaching, there is a need for a change in the referents that teachers use when implementing new pedagogical approaches. The referent, which act as organisers of teacher knowledge and take the form of beliefs and images, need to change from being centred on an objectivist to a more constructivist orientation.

Considerations for Conceptual Change

When considering a new conception, the teacher/learner needs to decide whether the criteria are met (Hewson & Thorley, 1989). Firstly, the new conception has to be intelligible -- the new concept needs to make sense to the learner. Secondly, the new concept has to be plausible -- the difference between this condition and the first is that for a concept to be plausible the individual must believe that the concept is potentially true. Even though an individual may believe that a concept is intelligible, this alone does not mean that the concept is regarded as being true. Plausibility incorporates the condition of a concept being intelligible as well as the possibility of truth. Thirdly, the new conception has to be fruitful -- to accept a new concept, that concept needs to be useful to the individual in, for example, solving problems that were not previously solvable, or helping provide new ways of examining a situation. The number of possible ways to view a concept as fruitful depends on the individual's conceptual framework and the relevance of the new concept to that framework. A conception becomes a source of dissatisfaction to the learner when it loses plausibility or fruitfulness, which is that an individual must lose faith in the ability of existing conceptions to solve some problems before initiating a search for new concepts (Hewson & Thorley, 1989).

Dissatisfaction lowers the individual's conceptions of the existing concept and may be considered as a precondition and necessary criteria for conceptual change to occur.

Gunstone and Northfield (1988) added a fifth criterion of feasibility for conceptual change when considering teacher inservice activities. A concept becomes feasible when individuals give greater priority to the new concept raised in an inservice session than others which are part of their professional and personal lives. Even though a concept may be intelligible, plausible, and fruitful, conceptual change may not occur unless the individual places greater importance on the new concept in comparison to the old concept.

Hewson (1992) who defines the status of a new concept the extent to which a new conception meets the three criteria of intelligibility, plausibility and fruitfulness, we will include the criteria of feasibility. Hence the status of a new concept has risen if all four criteria are met, but if, for example, the new conception is viewed by a teacher as being intelligible, plausible and fruitful, but not feasible, then it will be considered with the teacher's existing feasible conceptions and thus have a lower status. According to this conceptual change model, a major factor of the learning process is the status that new and old conceptions have for the learner.

The five criteria of intelligibility, plausibility, fruitfulness, dissatisfaction, and feasibility were used to frame an approach to the inservice programme informed by constructivism that is described in this paper. By modelling such an approach in an inservice programme with a group of science teachers, we were attempting to fulfill the five criteria for conceptual change model proposed by Gunstone and Northfield (1988).

Teaching Roles When Implementing Innovations

In this study, teachers were encouraged to change their conceptions of teaching and learning in science and develop new pedagogical skills which were informed by constructivist referents. As teachers are influenced by their own conceptions of teaching, building on the work of Habermas, that three levels or interests are attained in the process of teaching an understanding between theoretical knowledge and practice, namely, technical, practical and emancipatory. Each of these levels or interests, which are reviewed by Ewert (1991), represents an evolving development within the teacher and determines the role he/she will adopt within the classroom. For example, Grundy (1987) suggested that teachers move through seven stages of concern when involved with inservice programs which focussed on implementing new teaching approaches. In their study of the effects of a two-year inservice programme on the adoption of approaches to the teaching and learning of mathematics informed by constructivism, Simon and Schifter (1987) have identified similar stages of development to James and Hall. They noted three stages: firstly, no knowledge or use of constructivist epistemology, secondly, a mechanical application of constructivist approaches in which teaching behaviours are the focus rather than student learning, and thirdly, a focus on student learning rather than teaching behaviours.

However, there are difficulties in directly comparing the different stages for implementing innovations proposed by different authors because not all stages of the different authors have equivalent steps. For example, Grundy, in describing Habermas, does not define progress through the technical level in the same incremental manner as do James and Hall, and Simon and Schifter. Similarly, Simon and Schifter do not discuss an empowerment stage, whereas Grundy and James and Hall do. Examination of these interests or concerns is important because of the impact that each has in determining the role adopted by individual teachers in implementing his/her classroom practice.

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Tobin, K. (1993). "Constructivism and conceptual change need to be considered in the same way for students, teachers, and researchers." Education Policy Analysis Archives, 1(5).

To effectively develop the skills for implementing a teaching/learning approach informed by constructivism, we believe that teachers need to distinguish between content knowledge, concept knowledge and subject matter knowledge. For example, there is a need for clarity in the way in which content knowledge is defined and how it is interpreted by teachers. Wilson, Shulman and Richert (1987, p.113) have stated that teachers use their content knowledge - their understanding of the facts or concepts within a domain - as well as their grasp of the structure of the subject matter. Teachers must have a focused, substantive understanding of the subject and the importance of the organising structure of the discipline, that is, the links between facts, ideas and concepts is noted by Prawat (1990, p.30) who in discussing the difference between traditional and constructivist approaches suggests the major difference between the two is that the traditional approach views transfer as a decontextualised content knowledge. This emphasis on exploring the relationships between ideas, facts and concepts provokes for the discipline, that is, the links between facts, ideas and concepts is noted by Prawat (1990, p.30) who in discussing the difference between traditional and constructivist approaches suggests the major difference between the two is that the traditional approach views transfer as a decontextualised content knowledge.

A number of major studies of science classrooms (Tobin & Gallagher, 1987; Tobin & Espinet, 1989; Tobin & Francisco, 1990; Hmelo-Silver, 1990; Gallagher, 1991) have suggested that teachers within their classrooms are focusing on the rote learning of facts and algorithms, that is, decontextualised content knowledge. This conception of content knowledge has a much narrower definition than put forward by Wilson, Shulman & Richert (1987) and lacks the focus on concepts and organisational structures they believe are important. To encompass this broad definition there is a need for teachers to have a greater understanding and awareness of the conceptual knowledge of the topic they are teaching (Bennett, 1968). There is a need for teachers to have a clear conception of what ideas or concepts are central to the discipline and how they are related to one another (Prawat, 1989). Conceptual knowledge is viewed by the authors as being derived from the relationship between content knowledge and the context within which the knowledge is constructed and recognised and has the potential for illuminating for the physical and social world that otherwise would go unnoticed or unappreciated.

In responding to a series of workshops to address this area of focus on conceptual knowledge, Bowden (1988, p.260) stated that the teachers involved struggled when asked to go beyond a description of content areas, that is, they struggled with the concepts and their links. The teachers in fact realised that when focussing on teaching content knowledge "their normal teaching practices [were] incompatible with the desired outcomes". To bring these ideas more closely together resulted in the teachers' part towards a view of teaching as changing conceptions (Marton & Ramsden, 1988, p.276).

This in itself will require the adoption of new pedagogy (Millar, 1987) and pedagogical knowledge. Teachers will have to develop pedagogical knowledge which is centred on the teaching of conceptual knowledge, that is, pedagogical concept knowledge. Such pedagogical knowledge involves the use of negotiation and group work (Prawat, 1990), interpretative discussions (Mitchell,1987), and wait-time (Tobin, 1987). This pedagogical knowledge in conjunction with the pedagogical content knowledge centred on the narrowly defined content knowledge of teachers, will enable a broad understanding of pedagogical content knowledge which is constructed which is both reflective of the definition put forward by Shulman (1987).
The third phase took place over a full school year of 10 months and consisted of implementing new science units together with one full-day and one half-day inservice sessions. During this phase the teachers were involved in developing and implementing a complete unit of work lasting from three to six weeks using teaching/learning approaches informed by constructivism. Almost daily contact, via individual and whole group sessions, was maintained to provide the necessary support structures for the classroom teachers, observations, semi-structured interviews, and journal recordings were the data collection procedures used during this phase.

DATA COLLECTION PROCEDURES

Classroom Observations

Observations of classrooms were used to determine the number and type of interactions taking place between teacher and students. As approaches informed by constructivism are primarily student-centered, classroom observations were focussed on the number of interactions centred on the teacher or the students. Teacher-controlled activities were those where the teacher was the sole source of information, or organised the work to be done without any input from students. Student-centred activities are those in which students were able to determine the direction and practical situations undertaken were designed and implemented by students in response to questions posed by themselves. One difference noted as the teachers moved from technical implementation of the new teaching approaches to a more facilitative role in the classroom was that the number of student-centred interactions increased and the direction the lesson took was controlled much more by the students.

Conversely, student-controlled activities were those in which students were able to determine the direction of the lesson and the practical situations undertaken were designed and implemented by the teacher or the students. Teacher-controlled activities were those where the teacher was the sole source of information, or organised the work to be done without any input from students. Student-centred activities are those in which students were able to determine the direction and practical situations undertaken were designed and implemented by students in response to questions posed by themselves.

Metaphors

Lakoff and Johnson (1980) stated that "the essence of [a] metaphor is understanding and experiencing one kind of thing in terms of another" (p. 5). When applied to teaching, the type of metaphor(s) teachers use to describe their role in the classroom can be used as a guide to their beliefs about teaching and learning (Tobin, 1990). In listing the applications of metaphors for examining teachers' roles in the classroom, Tobin (1990) stated that metaphors can be used to conceptualise teaching roles and this conceptualisation can be changed in the process of changing the role. Further, when a role is recontextualised, the metaphor associated with the role can be deemed no longer applicable to teaching. In describing the change in roles required when using teaching/learning approaches informed by constructivism, Marshall (1980) suggested that teachers will have to move away from a workplace metaphor that includes an authority figure who has status and power. Thus, as teachers move to adopt constructivist approaches, metaphor can be a vehicle to describe the role of the teacher.

The teachers were asked to record metaphors in their journals on entry to the inservice programme and on completion of the unit they taught using constructivist teaching/learning approaches (Hand & Treagust, 1993). All the teachers initially used metaphors that indicated they were managers of classrooms. However, on completion of the teaching unit, changes in metaphors indicated that the teachers were in either a technical stage of implementing the new strategies and thus still dependent upon being managers or had become facilitators of learning. For example, a teacher who initially stated that teaching was about "getting the maximum power and speed out of the boat with little effort; however without the skipper the whole thing turns into a mass of flapping sails and ropes and gets nowhere." Before I may have been heaving into a strong wind - battling the elements and working very hard.

Another teacher who initially indicated her metaphor was that of a lecturer (manager) who "passes out information" changed at the end of teaching the new unit to a metaphor of social director. After reflection, he guiding metaphor was still centred on an authoritative role within the classroom.

Journals

Each of the teachers plus the first researcher kept a journal throughout the period of the study. The journals were used to record notes about the teaching-learning approaches informed by constructivism. After each inservice session, planning details, classroom observations, analysis of the readings and at various stages of the inservice program to record a metaphor to describe the teacher's classroom role. Information from the journals was coded with respect to the three questions used within the interviews. Results from each of the data sources was triangulated (Goetz & LeCompte, 1984; Kraft & Breimeyer, 1989) to ensure that the emerging categories were valid and "grounded" in those data (Spector, 1984). Participating teachers were given the opportunity to examine the changes they were making in their teaching/learning approach, and who they perceived to be in control of learning. Each of these interviews was coded in relation to these criteria and compared with the class teacher's interview responses. For example, if the class teacher stated that he/she was implementing pedagogical skills that were facilitative, but the student-centred and student-controlled tasks were not used, then there was some indication that the teacher was not clearly in the teacher-as-facilitator role.
learning to the students, that is, they were changing from a managerial role to a more facilitative role. On completion of the inservice programme the teachers were provided with opportunities to discuss the inservice model developed by the researchers. Planned science faculty meeting time allowed the teachers to discuss, examine and comment on the model. The teachers' major focus in these discussions was on the manager role identified by the researchers.

The inservice model describes stages in the development of teachers' pedagogical knowledge, discusses how these stages fit the criteria needed to promote conceptual change, and illustrates how these developments in knowledge bases and teaching roles can be examined as teachers experience the inservice programme. As the teachers' pedagogical knowledge changed as a result of their involvement in the inservice programme, we identified five stages of change as a result of the data collected from classroom observations, teacher and researcher journals, questionnaires, and semi-structured teacher and student interviews. These stages are presented in Figure 1 and illustrate developments of the teachers' knowledge bases and roles, and the five criteria for conceptual change. The first four stages of this inservice model closely resemble the four phases described by Driver and Oldham (1986) for a constructivist approach to curriculum development – documentation of current practice; review of background issues including the findings of research on children's ideas in the selected topic areas; development of revised teaching strategies and programs, and implementation of the review strategies. At the same time, the inservice model explicitly fits the conceptual change criteria of Posner et al. (1982), and Hewson and Hewson (1988), and extended by Gunstone and Northfield (1988). The inservice model attempts to fit teaching roles to the teachers' progression through an inservice programme based on teaching and learning approaches using constructivist referents and subsequent adoption of such approaches by the teachers.

Stage 1: Teacher knowledge of classroom practice

Prior to the inservice, teachers were asked to describe the teaching strategies they used in the classroom. Observations of the teachers indicated that all were working in an information transfer mode with an emphasis on ensuring that students were receiving correct scientific content knowledge. In other words, throughout this stage all the teachers emphasised control of students and content knowledge; the role adopted was managerial as noted by the metaphors the teachers used to describe their teaching, for example, a ring master, a coach of a football team, and a lecturer (Hand & Treagust, 1993).

Stage 2: Teacher identification of students' knowledge of science

Teachers were asked to determine students' understanding of science of a particular topic of their choosing and the researchers helped them use appropriate strategies to achieve this task, such as the free-writing process. During this stage, teachers were not asked to change their pedagogical approaches, only to conduct one lesson to examine students' ideas. As a result of having determined that students' Ideas were different from what they had been perceived to be, the teachers began to become dissatisfied with their pedagogical approaches. As an example of this dissatisfaction, during a discussion into the process of how to determine essential concepts to be addressed within a teaching unit, the teachers asked, after exploring the students' ideas, "what do we do now?" As the first author noted in his journal, this question also was posed by teachers individually during interaction during school visits:

It was out of this discussion [on concepts] that the role change came about. It was a little surprising to hear that "I don't know where to go from here" - even though they had the students' misconceptions in front of them. Gary was the only one who was not troubled by this. He stated that by jumping the barrier to address what the students knew was a little scary, but was the obvious thing to do.

Teachers at this stage stage had insufficient pedagogical knowledge of how to plan in order to challenge students' ideas and, apart from Gary, they were reluctant to attempt to do so.

Stage 3: Developing pedagogical concept knowledge

Teacher's knowledge of classroom practice

Teacher's role

Conceptual change

Stage 4: Broadening and refining pedagogical content knowledge

Pedagogical concept knowledge

Stage 5: Development of a constructivist teaching framework

Pedagogical Subject Matter Knowledge

Empowerer

Fig. 1: The five stage inservice program to implement constructivist teaching/learning approaches and the criteria which have been fulfilled
Stage 3: Developing pedagogical concept knowledge

Having undertaken the previous task and completed some of the readings on constructivism, the teachers participated in a series of discussions to determine the new pedagogical skills, such as conducting interpretive discussions needed when implementing teaching/learning approaches informed by constructivism. Particular emphasis was placed on the need for the teachers to combine a conceptual knowledge focus rather than a content knowledge focus when teaching science with the new pedagogical skills being implemented, that is, pedagogical concept knowledge. The researchers emphasised the need to provide new knowledge that was both intelligible and plausible for the teachers to actively reflect upon the fruitfulness and feasibility of the teaching/learning approaches being implemented. If the teachers were to change from their current practices to teaching/learning approaches informed by constructivism, they must see the new strategies as being fruitful and feasible.

As the teachers developed the necessary pedagogical concept knowledge through classroom implementation, they were able to judge both the fruitfulness and feasibility of using these approaches in the classroom. As a consequence, the role of each teacher changed from that of technician to facilitator, where issues were explored that directly focussed on the students rather than on the teacher. Initially the teachers' concerns had centred on such issues as syllabus coverage and their acceptance of the model and the changes they were making in the classroom. As the teachers developed the classroom implementation, they were able to observe the fruitfulness and feasibility of the teaching/learning approaches being implemented.

In summary, the role of teachers was to judge both the fruitfulness and feasibility of using these approaches in the classroom. As a consequence, the role of each teacher changed from that of technician to facilitator, where issues were explored that directly focussed on the students rather than on the teacher. Initially the teachers' concerns had centred on such issues as syllabus coverage and their acceptance of the model and the changes they were making in the classroom.

Stage 4: Broadening and refining pedagogical content knowledge

The teachers were allowed time to develop their own pedagogical concept knowledge. After trying various new skills, in particular defining student concepts, and reflecting on approaches to teaching and learning informed by constructivism, all participating teachers were asked to select a science unit to teach. Each teacher then was given time to develop and implement, in consultation with the researchers, a science unit informed by constructivist philosophy. Teachers were asked to record in their journals the planning sessions and observations made in implementing the approach, particularly student concepts, the progress of the concept, and the reactions of students to the new approaches. These journal entries enabled the teachers to actively reflect upon the fruitfulness and feasibility of the teaching/learning approaches being implemented. If the teachers were to change from their current practices to teaching/learning approaches informed by constructivism, they must see the new strategies as being fruitful and feasible.

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Stage 5: Development of a constructivist teaching framework

This stage centred on the development of a coherent teaching framework informed by constructivism. Teachers were encouraged to examine both their pedagogical content knowledge and the newly acquired pedagogical concept knowledge to promote a much broader and deeper understanding of pedagogical subject matter knowledge. The role of teachers in this stage becomes that of empowerment in that they allow students to become problem-setters, not problem-solvers, and provide much greater opportunity for students to set the direction of the topic of work under review. Whilst the teachers in this inservice programme did not reach the fifth stage in the development of using teaching/learning approaches informed by constructivism, we believe that this stage is a natural progression of the inservice model for teachers.

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PUBLIC SPEAKING FOR GRADUATE STUDENT TEACHERS IN THE DIPLOMA OF EDUCATION.

D.M. Murison Travers,
La Trobe University.

ABSTRACT:
Graduate student teachers in the Diploma of Education took part in a 10 hour elective on speaking in groups, aimed at helping those who were communication apprehensive or shy to overcome their fears. Confident speakers also took part, to provide modelling and assistance, and to learn ways of teaching oral communication in school. McCroskey's (1977) Verbal Activity Scale (VAS) and Personal Report of Communication Apprehension (PRCA) were used with an investigative model evaluating the programme (EvalProp) to compare the reactions of the more and less confident speakers to the activities. The less confident speakers claimed to benefit from the programme, which is outlined. Certain activities were preferred by confident speakers, and others by less confident speakers, reflecting the different ways each of the groups view themselves and their audience.

Public speaking for graduate student teachers in the Diploma of Education.

Teachers need to be able to speak to groups. The importance of their ability to interact with students is detailed in a review of research by Nussbaum (1992). Teachers need to help their students to interact with others, too, since class work is group work. In the one-year Diploma of Education for graduates, a ten-hour, five-session elective aimed at attracting both confident and shy speakers, the confident acting as models and also helping the shy. In addition, the exercises would provide examples for their own teaching of confident talk in the classroom.

Activities were designed to help shy students and to create situations where others would help them. Also important was motivational talk of the kind: “Everyone should help others to take part”, “You need to understand how it feels to be shy; think of something you don’t do well. For instance, at school I was no good at singing”, “You need to applaud everyone, whatever their efforts”, “Remember, your aim is not only to do well, but to make sure that others in your group do well, too.”

The activities, including whole group work, two teams groups, groups of three or four, pairs, and individual speeches, took place in a large studio. Eighteen student teachers took part.

DESCRIPTION OF THE PROGRAMME:
Session 1: Introductory exercises for being heard and seen.
(a) With everyone seated in a circle, aims and rules were introduced (100% attendance to pass; applause after every event; everyone to be included in every activity).
(b) The students were asked: ‘Who is a confident speaker? Who is quite confident? Who needs more practice? Who is nervous?’ The aim was for shy speakers to see that others (about half the group) felt the same.
(c) They then moved around the room to find a partner, talk with them about their history, interests, aims; take notes; and introduce them — reading if that felt safer, but thinking only about how the other felt, not about their own feelings while talking — so that shy speakers would focus away from themselves.
(d) Sitting in a circle, they took part in games where each person spoke a few words, performed simple actions, sat or stood, to get used to being heard and seen by the whole group.
(e) The group ended with a discussion of group behaviour, a theoretical base for understanding their own behaviour and the ways groups influence individual behaviour.

Session 2: How leaderless groups function.
From now on, direction of activities was handed to the group. The leader called a roll, set up activities for the session, gave directions for the following week, and called for reflection at the end (which sometimes did not happen if time ran out – a mistake).

The group was divided in half, without appointed leaders, with nine in each team.