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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 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 Post & Strike, Hewson and Gertz (1982) has received wide currency in science education research and 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 referents, 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 five 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 conception 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 intelligibility or fruitfulness. If, then, 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 commitment to 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. Building on the work of Habermas, that three Hewson (1992) who define the status of a individual's conception as being 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 developed 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 implement new approaches in the classroom, they are confronted with three important issues: how they adopt the new pedagogical skills; how they relate to the existing skills they use; and the roles they adopt while teaching. The roles or interests that are reviewed by Evert (1991), represents an evolving development within the teacher and determines the role he/she will adopt within the classroom. For example, Grundy (1987) expressed the need for teachers to have an interest in controlling the environment through rule-following action based on empirically grounded laws (p. 12) which implies controlling student learning. The basic orientation of the teacher defines the roles that teacher and students interact in order to make meaning of the world, and practical interest may be defined as a fundamental interest in understanding the environment through interaction based on the interpretive meaning of teaching approaches (Grundy, 1987, p. 14). Emancipatory interest is concerned with empowerment, the ability of individuals or groups to take care of their own lives in autonomous and responsible ways, and may be defined as "a fundamental interest in emancipation and empowerment to engage in autonomous acting arising out of authentic, critical insights into the social construction of human society" (p. 19).

Earlier research by James and Hall (1981) suggested that teachers move through seven stages of concern when involved with inservice programmes or 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 (1989) have identified similar stages of development to James and Hall. They noted three stages: firstly, no knowledge of 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 new teaching approaches. In his/her classroom practice.
Different Knowledge Bases

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 clear and substantive understanding of the discipline. 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 discrete, procedural and conceptual understanding of the subject. 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 discrete, procedural and conceptual understanding of the subject. 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 discrete, procedural and conceptual understanding of the subject.

A number of major studies of science classrooms (Tobin & Gallagher, 1987; Tobin & Espinet, 1989; Tobin & Fraser, 1989; Prawat, 1990; Gallagher, 1991) have suggested that teachers within their classrooms are focusing on the rote learning of facts and algorithms, that is, decontextualized 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, 1996). 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 aspects of the physical and social world that otherwise would go unnoticed or unappreciated. In reporting another series of workshops to address this area of lack 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 conceptual knowledge "their normal teaching practices [were] incompatible with the desired outcomes". To bring this into practice closely together requires agreement between the teacher's part towards a view of teaching as changing conceptions (Morton & Ramsden, 1988, p.276).

This in itself will require the adoption of new pedagogy (Millis, 1987) and pedagogical knowledge. Teachers will have to develop pedagogical knowledge which is centred on the teaching of conceptual knowledge, that is, pedagogical content 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 is 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 constructed from what we believe is the definition put forward by Shulman (1987).

The first phase, which took place over four months, involved a series of classroom observations which included a programme of seminar discussions and exercises designed to encourage the development of new teaching practices by asking the teachers to define criteria that they used to distinguish good teaching practices. The exercises as a whole were designed to help the teachers develop their teaching practices by asking them to define criteria that they used to distinguish good teaching practices. The exercises as a whole were designed to help the teachers develop their teaching practices by asking them to define criteria that they used to distinguish good teaching practices. The exercises as a whole were designed to help the teachers develop their teaching practices by asking them to define criteria that they used to distinguish good teaching practices.
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 session. 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. Teacher 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 and type 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. Organised practical activities were those in which his/her knowledge was used without any attempts to obtain student input. Conversely, student-controlled activities were 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 of the lesson took was controlled much more by the students.

As a teacher became more facilitative in his or her role, much more responsibility was given to students to determine and direct the learning pathways in order to examine the concepts being addressed. Discussion sessions became more frequent and much more student-centered whereas when teachers are in a more technical role, even though discussion sessions are held, restrictions are placed on the flow of information because of the teacher’s lack of confidence in exploring student thinking. Appropriate questioning skills needed to conduct interpretative sessions were developed as teachers moved more fully to develop facilitative skills, for example, the use of non-value judgemental responses to students’ answers and devil’s-advocate type questions to ensure that students have to defend the answers they put forward.

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 teachers roles and this conceptualisation can be changed in the process of changing the role. Further, when a role is re-contextualised, the previously 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 (1990) 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 from previous constructed pedagogical content knowledge to newly constructed pedagogical concept knowledge, new teaching roles can be detected via the use of metaphors.

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 first 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 (Hand & Treagust, 1993). This change in the teacher’s perception of the teacher’s and their own role within the changed teaching/learning approach, and who they perceived to be in control of learning. Each of these interviews was coded in relation to the 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 indicated by the teacher metaphors, teachers matched the skills. If these skills then there was some indication that the teacher was not clearly in the teacher-as-facilitator role.

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 inservice sessions, 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 & Bretmeyer, 1989) to ensure that the emerging categories were valid and “grounded” in those data (Spector, 1984). Participating teachers stated that the interviews provided feedback as to the validity of the emergent categories.

AN INSERVICE MODEL FOR IMPLEMENTING TEACHING/LEARNING APPROACHES INFORMED BY CONSTRUCTIVISM

Throughout the inservice programme, participating teachers were given the opportunity to examine the changes they were making in adopting and implementing teaching/learning approaches informed by constructivism. Teachers readily acknowledged their development of pedagogical skills enabling them to determine student understandings, be non-judgemental in responding to student answers, and allow more student-centred discussions. As each of the science units were completed and implemented using the new approaches, each teacher signaled the need for a concept-based curriculum. Recognition was given by them to the development of a new form of pedagogical knowledge, that is, pedagogical concept knowledge, although they did not use this term. In developing this knowledge, the teachers acknowledged the increasing, but still important, role for them within the classroom. There was a greater acceptance in handing over more control for
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 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

Having undertaken the previous task and completed some of 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. This is, pedagogical concept knowledge. The researchers emphasised the need to provide new knowledge that was both intelligible and plausible for the teachers to examine and discuss during this stage. To encourage teachers to try these new pedagogical approaches and at the same time reflect on their old pedagogical knowledge, small and whole group discussions were held. During the trials that occurred in this stage, the teachers acted as technicians (Hand & Treagust, 1991) as they would only implement the teaching/learning approaches outlined for them in the inservice sessions, rather than to attempt to explore the effects of the approaches. For example, all the teachers relied on the free-writing process as the one method to explore student concepts. As all the teachers were unfamiliar with the new pedagogical approaches during this stage, they were concerned about the need to ensure that they followed the implementation process, discussed during the inservice session, as closely as possible.

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 processes and consequences 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.

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 facilitator to teacher, 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 at a conceptual focus on time, catering for all students within the classroom and determining essential concepts to be addressed within a unit. On completion of the inservice programme, concerns expressed by the teachers not agreed to facilitate, rather than to teacher, all the teachers were unfamiliar with the new approaches and at the same stage the teachers acted as technicians (Hand & Treagust, 1991) as they would only implement the teaching/learning approaches outlined for them in the inservice sessions, rather than to attempt to explore the effects of the approaches. For example, all the teachers relied on the free-writing process as the one method to explore student concepts. As all the teachers were unfamiliar with the new pedagogical approaches during this stage, they were concerned about the need to ensure that they followed the implementation process, discussed during the inservice session, as closely as possible.

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 their 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 emPOWERers in that they allow students to become problem-setters, not problem-solving, and provide much 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.

SUMMARY

In using a teaching/learning approach informed by constructivism to conduct an inservice programme with a group of science teachers, the researchers developed and implemented a model that monitored teachers' understanding of new pedagogical knowledge and their roles in relation to the new teaching approaches. The inservice model is based on the five criteria for conceptual change and on the development of knowledge that occurred during this stage, the teachers acted as technicians (Hand & Treagust, 1991) as they would only implement the teaching/learning approaches outlined for them in the inservice sessions, rather than attempt to explore the effects of the approaches. For example, all the teachers relied on the free-writing process as the one method to explore student concepts. As all the teachers were unfamiliar with the new pedagogical approaches during this stage, they were concerned about the need to ensure that they followed the implementation process, discussed during the inservice session, as closely as possible.

While the teachers' own conceptions of science were not the focus of the study, consequential action of members of the group of teachers reflects their acceptance of the model and acknowledgment of the five criteria for conceptual change. The model has a role in helping teachers implement pedagogical concept knowledge and to develop an awareness of the processes and consequences of implementing change in the classroom.

References


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 a questionnaire evaluating the programme (Eval'Prog) 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 programme was designed to help shy students to create situations where others would help overcome their fears. Shy 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.

Teaching ecology at the middle school level.

The activities, including whole group work, two teams, groups of three or four, pairs, and individual speech, 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 what 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.