

Learning more about learning improves teacher effectiveness

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Abstract

The present study examines the possibility that teacher knowledge about learning may impact on the effectiveness of a school. It does this by improving the quality of teacher-learner interaction within a framework that integrates contemporary theories of learning with teacher change. It is referenced on the premise that teachers usually represent knowledge about learning episodically. To be optimally functional, this needs to be re-organised into a personal explicit verbal propositional theory comprising declarative and procedural knowledge. It examines the influence of this type of re-structuring activity on the display of teaching behaviours identified as effective, on teacher knowledge about learning and on student performance.

Thirty two secondary qualified teachers engaged in a professional development program that provided a framework for a reflective study of the learning process, analysis of key aspects of learning in their classes and the identification of the implications for teaching. Changes in teacher effectiveness were monitored in several ways: (1) changes in the display of effective teacher behaviours consistent with a social-constructivist model of learning, (2) changes in perceived ability to facilitate learning in classes and (3) changes in student performance.

The findings support the prediction that involvement in a systematic exploration of the learning process, with teachers explicating their knowledge of learning, impacts directly on the display of effective teaching behaviours and on their personal explicit theory of learning. As well gains in student performance are reported. Aspects of the change programme that were perceived to be most likely to facilitate change are identified. Future areas in which this type of study may develop further are discussed.

Recent examinations of the factors that influence school effectiveness have identified variables associated with teacher-learner interactions. The existence of this factor is hardly surprising since a major function of schools is to put in place contexts in which students can learn, and the more successfully they manage these interactions, the more effective the school is likely to be. While organizational aspects of schools provide the necessary preconditions for effective teaching, it is the quality of teacher-student interactions that determine it (Caldwell & Spinks, 1992).

It is reasonable then, to expect a strong nexus between teacher effectiveness and school effectiveness. Successful learning requires learner activity in several areas.

Contemporary social-constructivist theories of learning (Voight, 1994; von Glaserfeld, 1988) develop the notion of learners constructing knowledge in the social interactions by changing what they already know. The interactions foster various 'learning functions' that impact on a learner's existing knowledge in various ways. Examples of learning functions include having a purpose or reason for learning, being in a state of 'cognitive conflict', having an impression of the outcome or goal of the learning, reviewing what has been learnt, encoding the change in knowledge in long term memory and integrating it with what is known. The functions can be implemented either spontaneously by learners or they can be initiated, managed and directed by the teaching.

Teachers, through their selective and systematic use of a range of teaching procedures, can activate the use of these functions. The likelihood of learning and the quality of the learning outcome is determined by their activation. The extent to which teachers provide the opportunity for students to be challenged by a novel set of ideas and to link them with what they already know determines in part student motivation to learn them. The extent to which they provide the opportunity for students to encode ideas in long term memory determines in part how well the students will recall them later. For teaching to be optimally effective, teachers need to put in place the opportunity for the learning functions to be used.

It seems reasonable then, to expect that teacher knowledge about learning may influence the effectiveness of a school. A recent review by Scheerens (1992) supports this expectation. Factors that influenced effectiveness included structured teaching, use of learning time, provision of the opportunity to learn, monitoring student progress, students' self-perceptions as learners and attitudes to school and high expectations (Holdaway & Johnson, 1993; Mortimer, 1993; Scheerens, 1992; Stoll & Fink, 1994). One might expect that the likelihood of provision of these conditions would

depend in part on a teacher's knowledge of learning. Changing teacher knowledge about learning may be expected to change teacher and hence school effectiveness.

A recent concept in the discussion of school effectiveness is the high reliability organization or HRO (Stringfield, 1995). One of its perceived characteristics is that "failures within the organization would be disastrous" (Stringfield, 1995, page 83). Applied to schools, this issue becomes a consideration of how schools can optimally facilitate the learning of all students. This, in turn, focuses on those aspects of the teacher-learner interaction that can most reliably lead to learning. One, it is proposed, is teacher knowledge of effective learning.

Teacher knowledge about learning can be examined from various perspectives. The present investigation considers two; its quality and its relevance and availability of use. In terms of its quality, it has been noted with increasing frequency recently that teacher knowledge about learning is referenced on inappropriate theories. In her presidential address to the AERA in April 1994 Ann Brown argued that

"School practices are influenced by outmoded theories of learning and development that are relics of psychology's behaviourist past;"

and that

"Contemporary theories are making little headway in influencing school practices." (Brown, 1994, page 11).

In terms of its relevance and availability for use, teacher knowledge about learning is constrained by its organization. Knowledge about learning, as with knowledge in other areas, can be organized in various ways; in an explicit verbal propositional theory comprising declarative and procedural knowledge and in complete episodes that encapsulate the knower's set of experiences. For most teachers, knowledge about learning is organized principally in the latter form (Munro, 1994). Experience, represented as episodes, guides subsequent teaching actions. Actions taken and decisions made in classrooms are more likely to be justified on the basis of having worked in the past rather than being supported by specific learning propositions. While this type of knowledge is appropriate in similar future situations where the goal is to implement previously learnt regimes, experience by itself is insufficient in situations in which the transfer of knowledge to substantially different situations and in which the capacity to initiate and respond effectively to change are required. It is also insufficient in situations that focus on debate about theories of effective teaching or learning.

For effective teaching, teachers need to restructure their knowledge into explicit theories of learning that are based on their personal experiences. These theories generate testable propositions that can be investigated in teaching practice. They need to be compared with appropriate 'public' domain theories of learning so that they can benefit optimally from current cultural knowledge of learning. The present study examines the issue of whether teacher engagement in this type of re-structuring activity leads to an increase in teaching effectiveness.

The importance of professional development opportunity in teacher change was noted by Stoll and Fink (1994). Various approaches have been employed to facilitate change in teacher knowledge. Three of the most influential used to enhance teacher learning and curriculum innovation are direct instruction, peer coaching (Joyce & Showers, 1995; Neubert & Bratton, 1987) and reflection (Grant, 1984; Schon, 1987).

The present investigation used a structured professional development activity that combines aspects of these approaches to facilitate the restructuring process. Teachers engaged in a systematic analysis of their existing knowledge of learning and beliefs about learning. They tested these against empirical data collected by them and their colleagues in teaching and against contemporary theories of learning. They mapped their theories into teaching procedures and trialed these in their classes.

Assumptions were made about the nature of the theories of learning that individual teachers can be assisted to construct. It was assumed that teacher theories of learning are personal, derive from unique experiences and are transient in the sense that they are modifiable. It was also assumed that they can be seen to be comprised of a number of key components. Each component was thought of as a 'mental hook' on which learning concepts can be hung. Together, these components form a scaffold for organizing a person's knowledge about learning. Each component was mapped into an area of enquiry by the professional development activity.

The first component related to the nature of the learning process. It included a consideration of definitions, beliefs and attitudes learners have of learning, the structures of different types of learning outcomes, the conditions under which learning is more likely and the actions learners use to learn. The second component addressed variation in the ways in which learners learn and the implications of these for effective teaching. The third component examined the process by which learners show what they know, its influence on further learning, the relationship between this and assessment, the opportunities learners perceive they have for this and teaching

implications such as ways of broadening and automatizing the ways learners have to show what they know.

The remaining components addressed strategies for learning new content knowledge, ways of learning and positive attitudes to learning, the use of working memory space during learning, learning by reading, writing and listening, long term retention of knowledge, learning in different sociological contexts (individually, in small collaborative group and in large groups) and students learning to organize themselves as learners and monitoring their progress in learning. The various components were integrated into a scaffold or framework used by teachers to examine and restructure their implicit knowledge about learning.

The present investigation made assumptions about the means by which the restructuring could be facilitated within the context of the contemporary school community. It was assumed that teachers would be more likely to explicate their implicit knowledge when they (1) had a reason for doing this (that is, they were supportively challenged), (2) had an opportunity to engage in learning and change processes (that is, activities such as researching and evaluating their teaching, critical reflection of practice, responding to challenges, collecting classroom data and reflecting on it were demonstrably legitimised and valued in their teaching contexts) and (3) had the opportunity to implement change in their classrooms. These assumptions mirror the components identified as necessary for teacher change (Fullan & Pomfret, 1977; Grant, 1984; Schon, 1987).

Six main conditions were identified as necessary for teacher change: when teachers (1) had the opportunity to learn through active construction processes, (2) saw that their existing implicit knowledge about learning was valued, (3) framed up goals or challenges for learning (4) had the opportunity for individual and collegiate collaborative activities, (5) engaged in self-direction and systematic reflection of their practice and (6) explored and demonstrated new teaching procedures in their classrooms.

The importance of the learning being directed towards resolving challenges or solving existing problems held is not an explicit aspect of all models of teacher change. The five conditions for successful teacher change programmes identified by Joyce and Showers (1983, 1988), for example, don't directly ensure that participants frame up purposes for engaging in the change process. The professional development activity directly encouraged teachers to frame up challenges in relation to learning and teaching.

Teachers, like other learners, differ in their preparedness to engage in change and the rate at which they implement it. This preparedness is related to their implicit models of and beliefs about teaching and learning and their relevant conceptual knowledge (Joyce, Showers & Weil, 1992). The professional development programme recognised the need to take account of a variation from those who resist efforts to change their classroom practice, through those who are positive to small 'practical' change to those who are willing and prepared to change.

Change is more likely when teachers have the opportunity for both collegiate collaborative activities (discussion, team teaching, mutual observation of teaching, joint problem-solving) (Glatthorn, 1987) and individual participant activity, engaging in self-direction and systematic reflection (Glatthorn, 1987; Wells & Chang, 1986). The change programme used recognised this need.

The focus on school effectiveness in the present investigation is at the microscopic level, on the teaching behaviours displayed by individual teachers. This focus is supported by the plethora of more macroscopic studies noted earlier that have identified instructional influences on effectiveness such as structured teaching, effective use of learning time or motivation. The present study examines a mechanism for increasing the frequency of display of teaching behaviours that bring about these instructional outcomes.

The issue of identifying the teaching behaviours most likely to characterise effective teaching is no less difficult than defining effectiveness more generally. The present study used the learning principles identified by Brown (1994) for the community of learners, that is, a social-constructivist view of learning (Voigt, 1994). To provide these types of learning contexts, teaching behaviours in the following areas needed to be displayed; behaviours that (1) facilitated the efficient use of student attention and thinking while learning, (2) facilitated the display of positive attitudes towards content area learning and learning behaviours, (3) provided students with a range of options for learning an idea and for showing what they had learnt, (5) helped pupils to learn to organize themselves more efficiently as learners (6) developed learner-oriented behaviour management strategies such as on-task redirection strategies, (7) helped students improve how they learn, (8) assisted students to manage their learning in collaborative relationships and that (9) encouraged students to monitor their progress as learners. These areas of teaching behaviours provided a set of criteria for the evaluation of teaching.

The present investigation examined the prediction that exposure to a systematic exploration of the learning process by teachers increases the display of effective teaching behaviours and attitudes to learning.

The Design of the Present Investigation

Participants The participants were 32 qualified secondary teachers from three state and independent co-educational schools in eastern metropolitan Melbourne, teaching the range of secondary subjects. The schools elected to be involved in the programme and within these schools, the teachers were self-selected. All had been teaching more than 5 years (mean of 11.8 years of teaching post initial training, standard deviation of 5.3 years). Teaching experience was categorized as initial degree and diploma in education (43%), higher degree and diploma in education (7%), education degree or certificate (27%), trade or art diploma (15%) or 'other' (12%). Of the sample, 56% were female.

Prior to their involvement in the professional development activity, participants' knowledge of contemporary theories of learning and their personal theory of learning were assessed using an open-ended survey. Knowledge of contemporary theories of learning was assessed by asking teachers to outline their understanding of theories of learning. This was scored as; 0 if teachers displayed no knowledge, 1 for a display of vague, unrelated ideas, (for learning theories, for example, "Didn't Piaget test conservation"), 2 for a display of partial knowledge or 3 for a display of a substantial, integrated body of knowledge.

Personal theories of learning were assessed by teachers selecting and justifying five recent decisions they had made in their teaching in relation to students learning on the basis of what they believe about learning. Each decision was scored on the following scale; 0 if teachers justified their use in terms of earlier experience (for example, "I know that it always works" or "It worked in the past"), 1 for the display of a superficial explanation and 2 for an integrated explanation in terms of a contemporary theory of learning. The score for each teacher was averaged over the five decisions.

The professional development programme The professional development programme used was Facilitating Effective Learning and Teaching (Munro & Munro, 1992). This programme provides a framework whereby teachers work through a reflective study of the learning process, examine at first hand key aspects of learning in their classes and identify the implications for them as teachers. The nine components of learning that were used as focus for self-reflection are as follows:

- (1) The process of learning examined the following influences on learning; personal definitions of learning, beliefs about learning and one's self as a learner, the cognitive and metacognitive strategies used, learner assumptions about the nature or the outcome, the areas of learner existing knowledge activated, the goals and challenges framed by the learner, the personal metaphors learners have of the learning process and the social-cultural group in which the learning occurs.
- (2) Individual ways of learning examined the range of dimensions that explain alternative ways of learning and their implications for teaching.
- (3) The process of students displaying what they know examined the knowledge display process in the classroom, students differences in this process, student understanding of and beliefs about this process, the role of feedback, the display process and assessment , the opportunities students have for showing what they know in the classroom.
- (4) Learning new ideas examined the learning of conceptual and procedural knowledge, thinking and problem-solving procedures and strategies and attitudinal learning.
- (5) Managing concentration examined the concept of the thinking space as the site for learning, attentional short-term working memory processes in learning and their implications for teaching.
- (6) Facilitating remembering examined types of long term memory processes (semantic, episodic, etc.) and teaching strategies to help students to use these processes more efficiently.
- (7) Learning by reading / writing / listening examined the influence of the format of information input on the learning, the development of strategies to optimize efficient learning and to interact with emerging instructional technologies .
- (8) Learning in different contexts examined the influence of different sociological contexts of learning (learning in a large group, small group interaction, solo learning) the advantages and limitations of each and the most effective learning strategies for each.

- (9) Students' knowledge about learning and themselves as learners examines self-management of the learning process and includes managing one's self as a learner, monitoring progress, developing action plans and the learning episode as a personal model of learning, managing attitudinal knowledge, achievement motivation and learner attribution styles.

Each of these components were investigated in a three-phase teaching format. The 'model of teaching' or 'plan ... to design face to face teaching..' (Joyce, Weil and Showers, 1992, page 4) derived from an integration of contemporary social-constructivist theories of learning (Voight, 1994; von Glaserfeld, 1988) and information processing theories (Pressley, 1994). It proposed that learning is more likely when learners have the opportunity to learn through active construction processes, see that their relevant existing is valued, frame up authentic goals or challenges for learning, have the opportunity for individual and collaborative learning activities, for engaging in self-direction and systematic reflection of the learning and for exploring and transferring the learning outcomes. These were mapped into the following format for the professional development activity:

- (1) pre-session activity in which teachers researched and reflected on aspects of the component in their teaching. The pre-session investigative questions for the first component were:
- a. What beliefs do your students have about learning ?
 - b. What do they think learning means ?
 - c. What conditions do your students see as most effective for learning ?
 - d. What are the factors that they believe explain success or failure in learning ?

These research activities directed teachers to analyse their purposes for using particular teaching procedures and the assumptions and beliefs underlying their practices.

- (2) a seminar-workshop session in which teachers analysed collaboratively the component of learning from the perspectives of contemporary theories of learning and the data they have collected in the pre-session research. In most sessions they worked through learning activities that exemplified the component. They examined what the component meant for their teaching practice and developed sets of teaching procedures to research further.

These sessions are usually held fortnightly for two hours.

(3) post-session activity in which the teachers trialed aspects of each component further in their teaching and reported on-going evaluation in terms of whether they perceived students learning more efficiently at subsequent seminar sessions.

In summary, the programme involved teachers framing up challenges in relation to learning in their classes, researching these in their classrooms, discussing and analysing their findings collaboratively, re-orienting their action plans and gradually explicating their personal theory of learning.

Monitoring changes in teacher effectiveness. Changes in teacher effectiveness following participation in the programme were monitored in several ways:

- (1) changes in the display of effective teacher behaviours consistent with a social-constructivist model of learning (Brown, 1994; Voigt, 1994) were monitored for each participant by analysing twelve lessons; four successive lessons in a particular subject area with the same class taught prior to involvement in the professional development activity, four taught within a school term of the programme completion and four taught two terms after the completion of the programme. All lessons were audio taped. The types of teaching behaviours monitored were those
 - (a) facilitating the efficient use of student attention while learning, for example, encouraging students to automatize content knowledge, cueing the use of attention-allocation strategies such as "Tell yourself what you will do first, second...", "Plan how you will ..." or "Imagine what the final outcome of learning will be like". Statements that instructed students to "pay attention" or to "think more carefully" without cueing functional student behaviours were not categorized as positive instances of this type.
 - (b) facilitating the display of positive attitudes towards content area learning, for example, displaying a valuing of partially correct ideas, encouraging risk-taking in learning, exploring, asking questions.
 - (c) providing students with a range of options for learning an idea particularly when they had difficulty learning, for example, cueing students to visualize, to talk to themselves about ideas, to ask elaborative questions.

- (d) providing students with a range of options for showing what they have learnt.
- (e) helping pupils to organize themselves more efficiently as learners.
- (f) using learner-oriented behaviour management strategies such as on-task redirection strategies, providing options for unacceptable behaviours.
- (g) providing students with the opportunity to learn more about how they learn.
- (h) providing students with the opportunity to manage their learning in collaborative relationships.
- (i) encouraging students to monitor their progress as learners.

The number of instances of each behaviour in each four lesson period was recorded. The difference in mean number of instances before the programme, immediately after and two terms later was examined using planned comparisons for repeated measures procedures.

- (2) Changes in perceived ability to facilitate learning in classes was monitored using questionnaire and individual interview procedures. Teachers nominated areas in which they perceived their knowledge of teaching to have improved by the change programme. The percentage of teachers reporting each area was calculated.

Monitoring changes in student learning. Calibrated tasks that permitted comparison with a standard population were not available in several of the subject areas. Change in performance over time for groups of students in a subject was inappropriate, because content taught in the intervening period may have contributed to the change. Change in teacher knowledge over the course of the programme may have led to change in learning evaluation criteria.

Student outcomes were evaluated by having participants compile a set of criteria to assess the quality of matched learning outcomes for each student in each subject area at each grade level. The criteria were subject specific and in most cases, already included in the subject area curriculum so that the preparation of the set of criteria involved

minor modification of criteria that were already in use. The student outcomes included projects, models, sets of mathematics tasks, essays, pieces of art. Participants calculated a mean grade score for each subject taught before and after the professional development activity. As well, participants recorded their perceptions of changes in how individual students and groups learnt.

Outcomes of the investigation

Changes in the display of effective teaching behaviours consistent with a constructivist model of learning and in teacher knowledge and beliefs about learning are examined initially.

Changes in teacher behaviour The mean number of instances of effective teaching behaviours increased on completion of the programme ($F(1, 31) = 37.8, p < .01$). The increase in display of all types of effective teacher behaviours following the professional development activity was significant ($t(31) = 5.98, p < .01$, a priori comparisons for repeated measures) and was maintained two terms after the completion of the involvement ($t(31) = 6.43, p < .01$). The mean number of instances of each type of teaching behaviour across content areas is shown in Table 1.

Insert Table 1 about here

None of the teacher variables of age, level of qualifications, gender or length of teaching experience influenced the display of teaching behaviours ($p > .05$). The lack of influence of these variables suggests that the targeted types of teaching outcomes are not likely to be acquired only through 'teaching experience' per se.

Improvement was greatest in those areas associated with teachers analysing their teaching in terms of learning and implementing alternative strategies. In the area of classroom management, they were more likely to implement learner-oriented behaviour management strategies such as using on-task redirection strategies and providing student options for instances of unacceptable behaviour, rather than targeting the instance of unacceptable behaviour as separate from the learning activity.

Teachers were more likely to implement teaching procedures consistent with helping students to use more efficiently their attention while learning. They were more likely to cue students to use a range of self-instruction strategies such as "What does the task say to do? What will the outcome be like? What is it like that you already know? What will you do first, second, etc.?" When students were required to learn by reading,

they were reminded to clarify their purpose for reading, what they knew about the topic already and how they would organize the information as they learnt it. At the conclusion of a learning activity teachers were more likely to cue students to allocate attention to encoding the ideas learnt in long term memory.

Following participation, the teachers provided students with a wider range of options for displaying what they had learnt. This increased the likelihood of students receiving positive feedback for what they knew from teacher and peers and, in all probability, motivated in turn further learning. They also provided a greater range of options for learning an idea. They were more likely to cue students to visualize and verbalize ideas, to recode ideas from episodic or experiential to more abstract verbal-propositional form and to make multiple links between new ideas and their existing knowledge.

Opportunity for students to manage their learning in collaborative relationships with teachers and peers increased. This was displayed in the increase in less-directive teacher and peer responses to students' ideas ("Why do you think? But what about? Where would fit in?") as well as more-directive feedback in convergent learning, the opportunity for creative more-opened development of ideas and the development of 'group knowledge' as a resource in learning contexts.

Teachers provided more opportunities for students to monitor their learning and to see themselves making progress. At the beginning of lessons, teachers were more likely to indicate how student knowledge might change during the lesson. They negotiated ways of observing these changes with their class. At the end of lessons teachers were more likely to have students review how their knowledge had changed. Students were encouraged to implement their own 'action pathways' for monitoring their learning.

Changes in teacher knowledge.

Prior to the professional development program, participants' knowledge of contemporary theories of learning and their personal explicit theory of learning was comparatively undeveloped; their mean rating scores were 0.74 and 0.64 respectively. None displayed a more than a vague understanding of contemporary theories of learning. Few displayed evidence of a personal explicit theory of learning; 85 % of the explanations provided to justify teaching decisions were of earlier experiences (for example, "I know that it always works" or "It worked in the past",).

Following the program, participant knowledge in these areas increased; knowledge of contemporary theories of learning as they relate to teaching practice to a mean rating of 3.26 and explicit knowledge of their own theories of learning to a mean rating of 2.65. Both differences were significant ($p < .01$, 1-tailed t-test for repeated measures).

Teachers reported that the programme improved their knowledge and beliefs about learning (the learning process and the types of learning actions that they needed to foster and encourage by their teaching) and improved their perceived ability to facilitate learning in their classes and their understanding of meeting individual ways of learning in their teaching. Teachers believed that the programme led to an improvement in the delivery of classroom teaching in the school. These data are discussed in greater detail in Munro (1993). The areas of gain most frequently identified and the percentage of teachers reporting each are shown in Table 2.

Insert Table 2 about here

Teachers were more likely to perceive their teaching effectiveness improve in areas over which they had greatest control (for example teaching pupils to reflect on how they learnt, catering for a range of ways of learning in their teaching and using a range of cueing strategies). They perceived themselves as being least able to actually change pupils' dispositions to learning (for example, helping students to use a concept of the 'learning episode' in their on-going learning or to organize themselves more efficiently in their subjects). Several felt unsure about reporting improvement in this area because they were either not sure of precisely what students would be doing when they had improved or needed more time to be assured of changes in the general learning of students. These data suggest that teacher effectiveness change programmes may need to assist participants to identify what students will be doing when they are learning.

These outcomes support the direction of change in effective teaching behaviours shown in Table 1. Change was greatest in areas in which teachers were encouraged to interpret classroom events differently. Interpreting instances of inappropriate behaviour as possibly due to a mismatch between the learning demands made by a teaching procedure and student's preferred ways of learning or as a lack of opportunity for students to display outcomes that would be valued by the peer group or teacher were most readily assimilated into teachers' repertoires.

Change was least (though still significant) in areas in which teachers were required to implement activities from the perspective of learners, for example, procedures that

assisted students to organize themselves more efficiently as learners in their subjects or that provided them with the opportunity to learn more how they learn.

Changes in student learning outcome

Mean student gain scores were calculated by each teacher for each subject at each grade level. Given the diversity of subject specific criteria used in the assessment, only summary data are reported here. Of the 127 gain scores collated, 73 % indicated a substantial gain in the quality of learning outcome ($p < .01$, 1-tailed t-test for repeated measures).

This gain was not restricted to particular teachers, subject areas or year levels. Explanations of the distribution of this gain are complex. First, in the majority of the classes, some students achieved at a high level prior to their teacher's involvement in the programme. Improving teacher effectiveness was less likely to impact on the performance of these students on the criteria used. The performance of the lowest achievers in most conditions of subject area x grade level improved. In 85 % of these conditions, the mean score of the students in the lowest quartile prior to teacher involvement improved by at least half of a standard deviation after the involvement. Improving teacher effectiveness led to increased performance for many of the underachieving students.

Given possible limitations in the assessment of change in student performance and possible inconsistencies in the allocation of equal scores to different criteria in different subjects, further analysis of the relationship between teaching characteristics and learning gains is seen as inappropriate.

Subjective reporting by teachers suggested that students displayed a broader range of learning behaviours following the professional development activity. This finding needs to be interpreted in the context of the participating teachers increasing their knowledge of what constituted effective learning behaviours.

Aspects of the change programme identified as facilitating change. The identification of the aspects of the change programme that were most likely to facilitate change is important both for understanding the change in teacher effectiveness and for implementing future effectiveness improvement programmes. The monitoring of teacher change over the course of 2 semesters led to the identification of conditions under which change was most likely. Teachers' perceptions of when they were more

likely to integrate aspects of the approach within their teaching were recorded. The conditions most frequently reported by teachers were when they

- (1) reflected on and made explicit their own models of learning and teaching. Providing pre-organised teaching procedures based on 'sound teaching practice' was seen as insufficient. Teachers valued the opportunity to explicate and evaluate the implications of their beliefs about learning and teaching, to gather first-hand data from their students about aspects of learning, to have the opportunity to reflect on these data and relate them to their beliefs, to discuss them with colleagues, to use them to plan a course of action and then to trial the inferences. Teachers who reported trialing their own inferences and courses of action were more likely to report changing their approach to teaching.
- (2) were able to observe teaching procedures that facilitated learning being practised in their own classes. Teachers noted that a valuable component of the change programme was the opportunity to imagine how new procedures might be implemented in the context of content they would teach during the following weeks. They also valued the opportunity to role play a teaching strategy or to implement it with a small group of students first.
- (3) were using teaching procedures to solve temporary problems or challenges that were confronting them in their classes at that time. The recommended change in teaching procedure needed to be seen to assist in solving current problems. Teachers are more likely to adopt new teaching procedures that have the potential to solve existing problems. Professional development and teacher change programmes need to recognise this and to include, as a major aspect of the programme, the opportunity for teachers to explicate and explore solutions to existing problems.
- (4) experimented with the new procedure soon after seeing it. An optimal duration seemed to be of the order of two weeks.
- (5) observed student change in learning behaviour and outcome as a result of a teaching modification. Teachers who had identified specific student behaviours likely to suggest change were more likely to engage in further experimentation and more sustained change. Using an audio tape recorder or having a 'mirror' or a coach monitor it and being able to discuss its success with the colleague group contributed to the likelihood of teacher change.

- (6) initiated comparatively small changes initially. Not surprisingly, teachers noted small changes at the practical level were easier to handle successfully by an individual teacher than larger changes.
- (7) observed the change to be beneficial to a majority of students in their classes. Changes in teaching procedures that were useful or necessary for only one or two students in a class were more likely to be forgotten and certainly less likely to be integrated within the teacher's repertoire of teaching strategies.
- (8) had the opportunity to evaluate the teaching procedures as useful or not. Teacher evaluation of the effectiveness of the procedure was identified as important by several of the teachers.
- (9) saw that it was possible to predict and anticipate how students might learn.
- (10) felt confident that their peers validated the notion of change and research in the classroom, when they knew that colleagues were prepared to countenance the need to change and when they heard colleagues discuss positive outcomes.

The extent to which the new teaching procedures could be aligned with similar teaching procedures already in the teachers' repertoire was difficult to determine. In several cases the procedure did not seem to have to be like existing procedures, for example, a teacher who adopted the schematic map procedure with questioning had previously used a didactic lecture approach with little cueing of student background knowledge.

In summary, the findings support the prediction that involvement to a systematic exploration of the learning process, in which teachers explicate their knowledge of learning, impacts directly on the display of effective teaching behaviours and teacher attitudes to learning. The assumption that practising teacher knowledge of learning is usually represented episodically was supported. This knowledge becomes more generally useful when it is recoded into an explicit personal theory, tested against a practical data base (the classroom) and mapped into teaching procedures. A key issue in the recoding was the provision of a conceptual framework or scaffold that teachers used to develop their personal explicit theory of learning.

Discussion

The issue of improving the effectiveness of schools is characterised by its multifaceted complexity. The approach examined in the present study identifies teacher knowledge

of teaching procedures referenced on contemporary theories of learning as one of these facets.

The study is exploratory in several respects. One relates to the identification of effective teaching behaviours. The present study identified behaviours consistent with a social-constructivist model of learning (Brown, 1994; Voigt, 1994). Future validation investigations may indicate the extent to which this set of teaching behaviours needs to be modified. One might expect that the teaching behaviours most likely to target effective learning need to account for learner variables (such as the structure of learners' existing knowledge and approach to learning (cognitive style, memory and affective learning factors)), the desired learning outcomes and learning context constraints.

The present study examined the display of integrated sequences of teaching procedures. Matching these with the learning characteristics of students and groups also merits future consideration. The professional development used in the present study assisted participants to implement and trial instructional procedures that matched learner characteristics. Future studies may provide teachers with validated teaching procedures.

A second issue relates to the criteria for teaching effectiveness in terms of student learning gains. Studies have used changes in English and mathematics performance (for example, see Hill, 1995). The present study attempted to monitor changes in learning performance in a range of subject areas. The measures involved assessment of 'equivalent' or matched student learning outcomes in terms of a set of subject-specific criteria. To ease additional teacher work load, these were usually existing assessment tasks and required minor modification and explication of criteria. As noted earlier, this approach to assessment had particular inherent faults.

The importance of establishing and validating student changes with changes in teacher effectiveness cannot be overemphasised. At a more global level, it will be the measures of student learning outcomes that will indicate whether learning has been more effective. At a micro level, individual teachers need to be aware of the types of student behaviours that are indicative of more efficient learning. Knowledge of how to monitor and 'make sense of' student behaviours may be expected to assist teachers to assess the relative effectiveness of particular teaching procedures. It also allows teachers to receive valuable motivating feedback and to re-orient particular aspects of their teaching if necessary.

There would seem to be a need to measure changes in learning outcome in terms of the display of effective learning behaviours in classrooms by teachers, as well as in terms of more global achievement outcomes. The present study encouraged teachers to monitor a range of effective learning behaviours, including how well students allocate their attention while learning, use a range of task-relevant learning strategies, display what they have learnt, organize themselves as learners, manage their learning collaboratively and monitor their progress as learners. Student perceptions of classroom learning effectiveness are also relevant. Procedures for identifying and monitoring effective learning behaviours in an on-going way in the course of regular classroom learning require further work.

A third issue relates to the context for the changes in teacher effectiveness, the educational institutions. The gains reported in the present study were in the context of notionally supportive collegiate networks in secondary schools. From a practical perspective the teachers involved needed to make opportunities for themselves to engage in the change activity. By virtue of their self-selection, they entered the activity oriented towards submitting their current practice to self-scrutiny. Their reasons for nominating ranged from a curiosity about contemporary theories of learning to seeking additional teaching strategies for dealing with issues arising in their classes. Their positive attitude towards self-direction of change in practise provided an impetus for involvement. While their school administrations supported in principle their involvement and were prepared to accommodate, where possible, changes recommended by the teachers, the schools did not resource practically their research activity by providing study time.

The teachers consistently reported confronting barriers that impeded progress towards more effective teaching. These are reviewed briefly here because other groups of teachers, intending to undertake similar change programmes towards improved teaching effectiveness, may encounter similar impediments. The barriers had a range of sources; colleagues' political views, institutional expectations and structural processes, economic restrictions and competing demands for effort. Recognizing these and analysing them from a learning perspective frequently assisted teachers to identify ways of circumventing them. Administrative and structural impediments were as much based on inappropriate theories of learning as was teaching practice. Participants noted that administrators were as prepared as teachers to modify their work so that it was referenced on more appropriate theories of learning when means of achieving this were identified.

This issue points to the need to embed teacher-learning and change programs within a school improvement strategy. The change component of the strategy would identify goals for the change program, both for teachers and students, validated clusters of teaching procedures shown to lead to enhanced student learning and achievement, a long term action plan for incorporating these into the teaching program and appropriate models of teaching. Collegiate and individual change programs would be included. The strategy would need to acknowledge that teachers enter the program with differing in existing knowledge about effective learning and teaching, preparedness to engage in teaching-change programs and strategies for implementing and managing change in their teaching.

The strategy would need to identify progressive indicators of change at the teacher and student levels. This sequence would provide a self-monitoring and referencing scale. The plan also needs to identify procedures for gathering data about the change in student learning outcomes, student and teacher perceptions of teaching effectiveness and knowledge about how to learn. These data would be used for re-orienting and fine-tuning the change program. The strategy would also consider policy and mechanisms for the involvement of the broader school community in the teaching effectiveness programs.

Teacher effectiveness, or more appropriately, teaching effectiveness, is intimately related to school effectiveness. School effectiveness will improve in parallel with change in teaching effectiveness. The present study is one attempt at improving teaching effectiveness. It has shown that a study of learning can impact on teacher practice and lead to significant improvement in teacher practice and school effectiveness.

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Table 1

The mean number of instances of each type of teaching behaviour for each lesson, across teaching areas and teachers.

Types of general purpose teaching behaviours	Before	After	2 terms later
Facilitating the efficient allocation of student attention while learning	0.2	8.6	8.2
Facilitating the learning of positive attitudes towards content area learning	0.5	6.3	5.8
Providing students with a range of options for learning an idea particularly when they were find learning difficult	0.3	7.1	8.9
Providing students with a range of options for displaying what they know or have learnt	0.4	7.6	9.4
Helping pupils to organize themselves more efficiently as learners in their subjects	0.3	5.1	5.8
Using learner-oriented behaviour management strategies such as using on-task redirection strategies	0.7	11.8	10.5
Providing students with the opportunity to learn more how they learn	0.2	4.8	4.9
Providing students with the opportunity to take control of their learning in a more collaborative relationship	0.6	7.6	9.4
Providing students with the opportunity to monitor their own learning and to see themselves progressing	0.3	6.8	7.9

Table 2

Areas of gain most frequently identified by teachers (% of teachers reporting each area)

Teacher understanding	% of teachers reporting the area
learning to analyse the demands their teaching style and content taught made on learning	83
teaching pupils to reflect on how they learn and helping them learn more effective learning strategies	76
developing ways of monitoring and evaluating the effectiveness of their teaching	69
catering for a range of ways of learning in their teaching	65
learning to use a range of cueing strategies as part of their regular teaching	64
using students' existing knowledge in a range of ways, tapping into knowledge in episodic memory as well as semantic memory	62
giving students a range of options for displaying what they knew	61
understanding the role of attention in learning, helping students learn to use it most effectively when learning	59
learning ways of researching particular teaching innovations in their classes	48
distinctions between different types of learning outcomes (such as deep and surface learning) and to teach for each type of outcome	46
helping pupils learn more positive attitudes towards learning	45
giving students a range of options when they are learning, particularly when they find learning a particular idea difficult to learn, modality switching	45
becoming aware of the concept of learning and teaching models and the expectations attached to each and how these influence the actual learning programme	43
helping students to use a concept of the	

'learning episode' in their on-going learning	37
helping pupils to organize themselves more efficiently in their subjects	34

