

# WORKING FROM THEORY: DEVELOPING THE BASES OF TEACHERS' CRITICAL THINKING PEDAGOGIES THROUGH ACTION RESEARCH

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This paper describes how an action research process enabled teachers in a specialised teaching unit for teaching critical thinking to develop their pedagogical practices to support student cognition. It argues that a well-structured action research approach supports and enables teachers to link theory to practice in developing their pedagogy, especially where such development implies a shift away from content and curriculum-oriented pedagogy. The conclusions from this study support four key mechanisms as crucial to the development of critical thinking pedagogy and describe how action research can support the advent of such mechanisms into pedagogical development programs that have the capacity to contribute to significant and sustainable change. Where support of student cognition is the goal, conclusions from this study show that pedagogical development is predicated on a basis in theory, but with a focus on independent practice in a culture of collegial collaboration and dialogue.

## 1. Introduction

There is growing recognition globally of the need to teach critical thinking as a means of supporting students to become the knowledge makers of the future. Although there is much debate about what '21<sup>st</sup> century skills' graduates will need, it is clear that a range of *transferable* cognitive skills will figure prominently among them — skills that enable individuals to move across a variety of work environments or areas of research and innovation. 'Critical and creative thinking skills' are frequently mentioned in attempts to codify the educational goals of the era. The *National Declaration on the Educational Goals for Young Australians*, for example, makes explicit the connection between critical and creative thinking and future economic stability, stressing the importance of "*general capabilities that underpin flexible and analytical thinking, a capacity to work with others, and an ability to move across subject disciplines to develop new expertise.*"

The Australian National Curriculum aims to specifically develop Critical and Creative Thinking as a general capability. The Australian Curriculum, Assessment and Reporting Authority

(ACARA) articulates these thinking skills in the same manner as literacy and numeracy: foundational individual personhood and essential to students' future learning. ACARA (2019) also views these skills as needed to respond “*to the challenges of the twenty-first century – with its complex environmental, social and economic pressures...*”

Both within specific classrooms and across school systems, the imperative to better support student cognition necessitates change in the professional development and pedagogical practices of teachers and the way these are supported. This is especially true in the Australian context where educational policies have tended to focus extensively on curriculum content<sup>1</sup>, rather than the thinking practices of students and how they may be supported by teachers. Here, arguably, the ambitions of governments to ensure a well-equipped future labour force are outrunning deliberative attempts to think through the consequences for teacher training (or retraining) and the shifts in the cultures of classroom practice needed to bring these educational goals to fruition. What exactly, after all, is involved in creating a classroom that fosters “flexible and analytic thinking”?

Despite the ongoing discussions about the importance of critical thinking in the classroom, very little work exists which sufficiently addresses the transformation teachers and schools should undertake to achieve this change – that is, not just what teachers have to know about critical thinking but how they should learn what to do with it in the classroom. This includes issues around curriculum development, the role of content, and working within school cultures and institutional frameworks to create thinking classrooms.

Herein, we consider a program of professional development that occurred within a specialized unit for teaching critical thinking supported by the Queensland Department of Education, Australia, called *Solid Pathways*. Activity in this unit is directly supported by the University of Queensland's Critical Thinking Project (UQCTP) and makes use of the pedagogical framework that is central to this program, known as the Pedagogical Schema for Teaching Critical Thinking (PSTCT) (Ellerton, 2015, 2016). Having received training in this model and its theoretical foundations, teachers within the Solid Pathways unit engaged in a cyclical process of action research to develop their critical thinking pedagogy into a more comprehensive approach to supporting student cognition.

The data gathered through and about this process reveal important lessons about how critical thinking pedagogy may be developed. We describe these lessons in terms of gains in *Pedagogical Content Knowledge* (PCK) — that is, the special category of knowledge that

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<sup>1</sup> There are learning objectives for Creative and Critical Thinking but no formal mechanisms to support the development and implementation of pedagogies

enables teachers to make content knowledge (in this case, critical thinking) teachable. A whole body of research has been dedicated to the nature of pedagogical expertise, encompassed under the theory of Pedagogical Content Knowledge. Pedagogical Content Knowledge (PCK) has been defined as a way of knowing that is unique to teachers, whereby they take an aspect of subject matter and “transform their understanding of it into instruction that their students can comprehend” (Shulman 1986: 8, cited in Fernandez-Balboa & Stiehl 1995: 293). As such, out of content knowledge, teachers must develop a further category of knowledge-for-teaching in order to develop practices that allow for optimal learning among students.

Research to date has shown that the development of PCK is a complex and sustained undertaking involving the interaction of a variety of factors, including teachers' epistemological conceptions of teaching and learning, the culture of their institutions and institutional frameworks that they work within, the reward and disincentives for certain types of teaching related activity, and the degree to which they undertake critical professional reflection on their teaching (Jolly 2016). Accordingly, PCK for critical thinking — that is, the expertise for the complex and considered suite of teaching practices required for optimal teaching of critical thinking — is itself a worthy subject for critical thinking research. An account of how PCK for critical thinking can be developed can therefore make a significant contribution to educational research.

Examined through the lens of developing PCK, the PSTCT and its associated resources represent a significant step forward in the task of transforming classrooms into sites of more autonomous and engaged learning through a shift in focus from content delivery to student cognition. However, in Solid Pathways, it was the culture of continuous development, achieved by engaging in action research, which allowed teachers to develop towards a comprehensive body of PCK for teaching critical thinking. This action research was done in conjunction with the University of Queensland Critical Thinking Project.

### **1.3 The University of Queensland Critical Thinking Project (UQCTP)**

The UQCTP works to theorise and put into practice explicit and transferable schematic understanding of teaching expertise when teaching is focussed on student cognition. This approach is not so much about what excellent teachers do, but on what they think while they are doing it. The program therefore aims to foster participating teachers' individual learning, focusing on a deep understanding of pedagogical principles to inform practice, and in which clear criteria for success allow for feedback to improve understanding. This approach is

expressed in the conceptual framework of the program, the Pedagogical Schema for Teaching Critical Thinking (PSTCT) (Ellerton, 2015, 2016).

The UQCTP maintains that teaching for thinking is a pedagogical project, it is not a curriculum project. The focus is on supporting teacher expertise and recognising that the most important resource a school has is its teachers. A key activity within the project is therefore to provide professional development training for teachers that allows them to better support and promote student cognition by working with the PSTCT and associated resources to develop their own, context-specific pedagogical practices. In this respect, the training provides structure to developing teaching for critical thinking, without prescribing specific programs or activities to be implemented by teachers. The theoretical bases of this schema are discussed in other extensively in existing publications (Ellerton et al. 2015, 2016 and forthcoming)

## **2.1 Data from evaluation of the open professional development program**

Existing data available from the evaluation of the UQCTP training activities reveal important considerations for the task of developing teaching for critical thinking. These data are available to the research team via evaluation surveys conducted with teaching staff upon completion of the training. Whilst much of the data from this source are descriptive in nature and focus on participants' perceptions of the quality and value of the training, open-ended comments provided by teachers suggest four main mechanisms required for formal training or professional development to be able to effect change.

The first is related to *the role of theory* or thinking about thinking, for example, in comments such as that their interest during the training was in "ways of thinking": "I appreciate understanding what thinking actually is," "system one versus system two thinking,"<sup>2</sup> "thinking as inquiry, inquiry as thinking," and "defining critical thinking." The prevalence of these comments throughout participant responses indicated that participating teachers valued the opportunity to consider and discuss the nature of thinking at a theoretical level, and that it is a necessary precondition to developing teaching of critical thinking to have the opportunity to develop their own theoretical bases for the task.

The second theme revealed in the comments indicated that teachers valued the *practical activities* that were included in the training. Comments about this included such statements as "the activities and examples provided clearly allowed me to review my own practices," "activities to model skills," "the practical applications," "links between theoretical

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<sup>2</sup> A reference to Kahneman's (e.g., 2011) two types or systems of thinking.

and practical” and “lots of examples to demonstrate system one and system two thinking.” Clearly, practical examples were important to teachers in considering how the theory presented would apply to their practice, indicating that a key challenge to overcome is to address the theory/practice nexus; that is, thinking through the practical implications that the theory has for how teaching should be carried out. Some teachers specifically commented that they needed to think about the theoretical aspect before they could consider the practical, and this is an important point about the necessary basis in theory of professional development for critical thinking training. Teachers themselves, in other words, realised that applying critical thinking in the classroom required more than merely “technical solutions” (McDonough 2012).

Another theme that emerged related to the value of *specific materials* for teaching critical thinking, including the Q-Matrix (a question-starter matrix for students to use in designing their own inquiries), the Critical Thinking matrix (cross-referencing cognitive skills and values of inquiry) and the explicit presentation of the PSTCT framework. Many comments simply listed these things as useful, but others explained why. For example, participants valued “visual references, especially on the schema, (that) placed the links clearly for me,” and “the link between cognitive skills and values”. Such comments give an indication that teachers not only engaged with the theory, but that the PSTCT and its resources provided a “link” to issues for practice and application in the classroom in the form of resources that teachers use to support decisions about instructional activities and practical pedagogical decisions. This should be considered a necessary step in the development of PCK for critical thinking.

Also represented in teachers’ open responses is the notion that *processes of collaboration* and the sharing of practices among teachers are central to the development of PCK in critical thinking teaching, and that to pursue pedagogical change further, some kind of collaboration with their colleagues would be required. These comments are in direct support of the fundamental ethos of the UQCTP which emphasises collaborative learning through individual practice.

Analysis of research data from Solid Pathways shows that these four key mechanisms also played a significant role in the professional development that occurred within the Solid Pathways unit, with each area proving to be central to the nature and degree of development that occurred. We therefore argue below that these mechanisms are significant to developing teaching that supports student cognition.

## **2.1 The Solid Pathways program**

In this section, the *Solid Pathways* program is explored in how it uses the PCK framework, after which their experiences are discussed. *Solid Pathways* is a critical thinking and university engagement, select-entry program for Aboriginal and Torres Strait Islander students from Queensland State Schools:

Solid Pathways is a unique, academic extension program that supports high achieving Aboriginal and Torres Strait Islander students. The program aims to assist students continue their academic success from Year 4 to Year 12 through the acquisition of higher order thinking skills.

Students are invited to participate in weekly one hour culturally inclusive web-conference lessons designed to develop their capability in critical and creative thinking. Lessons will connect students with other high achieving students from schools. (The State of Queensland (Department of Education and Training), 2016, p.1-3)

The focus on critical thinking and supporting student cognition are pursued in the program through the following specific aims:

To help students achieve by:

- increasing capacity to analyse and evaluate information
- enhancing their clarity of thought and expression
- improving writing and communication skills
- understanding relationships between evidence and hypotheses
- applying standards of evidence to detect fallacies in reasoning
- increasing the ability to make reasoned judgements
- engaging in autonomous problem solving
- developing a range of personal and interpersonal qualities, including confidence, autonomy and ethical awareness. (The State of Queensland (Department of Education and Training), 2016, p.1-3)

To provide State Schools Staff:

- professional development in critical and creative thinking
- a bank of critical and creative thinking resources for classroom use. (Department of Education and Training), 2016, p.5.)

The unique nature of the program means that the role of a Solid Pathways teacher differs from that of general classroom teachers. Although Solid Pathways teachers usually come from a general classroom background, in the unit they teach specific classes for developing thinking skills in online sessions that are not tied to a traditional school curriculum. In 2016, the unit was run with a team of 6 teachers and a department Head. The sessions last for one hour per group, but teachers will teach the same lessons multiple times in each week

of the school term. In addition to this teaching load, teachers work individually and collaboratively to develop units of work and specific lessons and gather data to monitor and assess student performance. The units are structured according to a focus on various cognitive skills and values of inquiry (drawn from the PSTCT resource the Critical Thinking Matrix) but are also aligned to general capabilities drawn from the National Curriculum. In this way, teachers pay attention to directly relating the learning in the online sessions to the work that students do in their normal classrooms.

## **2.2 The use of an action research framework to support professional development in the unit**

As well as undertaking formal PSTCT training provided by the UQCTP, the 2016 cohort of Solid Pathways teachers undertook an action research process as a means of pursuing pedagogical development for teaching critical thinking in a sustained and ongoing way. Action research was chosen as a way to engage the teachers in a professional learning community based on collaboration and professional dialogue. An inquiry model provided structure to the process and helped teachers to examine and interpret information from their teaching to identify specific problems of practice that, if addressed would make a significant difference to teachers' pedagogical practices and, by consequence, student outcomes.

A list of intended outcomes of the action research process was set by the teachers themselves, as follows:

- Develop a bank of evidence-based strategies to incorporate critical thinking pedagogies in everyday classroom practice.
- Build teachers' pedagogical expertise in teaching Critical thinking
- Engage Aboriginal and Torres Strait Islander students
- Expand teachers' understanding of critical thinking and develop common understanding of critical thinking skills
- Deploy evidence based critical thinking pedagogies through change in practice, and
- Engage teachers in professional development through self-reflective inquiry.

In order to start the process, teachers were asked to identify a problem area with their teaching, or simply an aspect of their practice that they would like to improve which they believed would have a positive effect on their students' cognition. They gathered feedback from students in the form of simple surveys about the online sessions to inform their considerations of how to act on the problem they had identified or the area of practice they wished to target. Data from these surveys provided a starting point for thinking about areas to change or develop. They were then required to consult scholarly literature on their area of interest to inform their thinking on a plan of action or instructional techniques to trial during

teaching sessions. When carrying out trial actions, teams of teachers would observe each other's sessions with the target outcome or type of change in mind and provide structured feedback on the observed lesson. This feedback and the teacher's own observations about lessons would then inform a critical reflection phase in which teachers could evaluate their trial practices and identify findings or outcomes which would then inform the next cycle of inquiry.

In addition to the self-reflective process, teachers would also report to the teaching team as a whole during the action planning phase (concerning their intended actions with justification from their scholarly reading) and the evaluative phase (concerning what they observed or concluded from taking action). Teachers were divided into teams, with groups of pairs either operating in the action phase whilst the other evaluated (following a cycle of alternate active weeks and reflective weeks).

### 2.3 Data from ethnographic observation in the unit

The sections below discuss data gathered through an ethnographic approach to observing professional development activity within the unit. Throughout 2016, a researcher followed this activity through observation of both formal and informal staff development sessions and activities, interviews of staff and documentary analysis of documents produced in the unit. Observational and interview data were captured as per Table 1.

<b>Date</b>	<b>Activity</b>
29 February	Action research development session and staff meeting in SP unit
7 March	Action research development session and staff meeting in SP unit
7 April	Internal PD for Solid Pathways staff discussing teaching practice
5 May	Internal PD for Solid Pathways staff with Peter Ellerton discussing questioning practices used during lessons
26 May	Action research cycle – teachers observing and giving feedback on each other's lessons
23 June	Action research development and reflection session (all SP staff)
23 June	Interviews with Solid Pathways teachers
18 July	Internal PD for Solid Pathways staff discussing teaching practice



1 August	Internal PD for Solid Pathways staff on embedding Indigenous perspectives (with visiting staff from DET)
4 August	Training day for all teachers in Critical Thinking Framework (Peter Ellerton)
22 August	Webinar run by SP staff for classroom teachers about the approach and methods of the program and how the online sessions are run
25 August	Training day for all teachers in Critical Thinking Framework (Peter Ellerton)
13 October	Advanced PD with Peter Ellerton, with Solid Pathways staff presenting about how they have developed their pedagogical practices
2 November	Follow up interview with SP teachers and HoD
11 November	Action research focus group (all SP staff)

**Table 1 – Observational and Interview data gathered in Solid Pathways 2016**

The professional development sessions observed included staff team meetings discussing particular goals or tasks for teachers in the unit, action research planning and teaching reflection sessions, outreach webinars run by teachers, as well as formal professional development sessions with external trainers. Documentary analysis of unit and lesson planning, student portfolios and of teachers' observation records from the action research was also undertaken. Teachers were interviewed as a means of analyzing their underlying ideas about the nature of teaching and learning, particularly when critical thinking was the subject. This combination of data collection activities was revealing about the pedagogical development process for teachers in the unit. All of the professional activity that was observed within the unit was specifically and explicitly geared towards developing pedagogical practices in keeping with the underlying philosophy and approach of the PSTCT.

### **3.1 Discussion and Findings**

Several significant implications can be drawn from this action research, particularly around collaborative collegial pedagogies as well as changing the dispositions of teachers themselves. Whilst data created and gathered by the teachers themselves through the action research process served them individually in developing their practices, the ethnographic data from the unit as a whole revealed the process by which PCK for teaching critical thinking was developed throughout the team. Analysis of these data revealed that developing a common language for the application of the critical thinking theory, along with developing a

shared, context-specific teaching resource for mobilising the concepts of the PSTCT and working collaboratively to do so, all contributed to teachers making a significant epistemological shift in their teaching practice. Specifically, this process allowed teachers to move away from a content-oriented and mechanistic mode of teaching towards a focus on the development of students' metacognition, particularly in terms of giving space to student voice, of listening to student ideas and opinions, yet emphasising the development of reasoning and justification, the verbalization of thinking processes and a manifestation of "learning about learning." This epistemological shift is appropriate to both the aims of the program and the approach of the training and is indicative of more developing PCK for critical thinking, in which teachers focus on student understanding over and above subject matter (Jolly, 2016)

### **3.2 Collegial activity and developing a common language and specific resources**

Throughout the investigation, collegial activities took place around developing a common language for and application of the theoretical frameworks that the training had provided. This consisted of a series of staff meetings in which unit planning, pedagogical reflection and conceptual development were undertaken. This approach was observed to form the basis of action research and professional development work that occurred throughout the year, with regular team-based planning, discussion and reflection occurring. Over this period, teachers developed their own term-based unit and lesson plans and assessment instruments for mapping student achievement with increasing depth and sophistication, as evidenced by the types of plans that were produced at the beginning of the year compared to the end of the year.

Developing a common language for critical thinking concepts was also supported through teachers working on the development of a teaching resource for representing the core concepts of the critical thinking framework. In the final resource that resulted, these concepts are represented as the interconnected parts of the culturally significant *Bunya Tree*, with Intellectual Values (Values of Inquiry) forming the roots of the tree, the Cognitive Skills forming the branches which support the canopy of Virtues of Effective Learners. Alongside the tree analogy the character of the Deadly Detective (a dingo) used a set of icons representing the intellectual values as a guide in the process of critical inquiry. These representations of the theory of critical thinking are now used in online sessions in the unit to help students (most of whom are in primary school) to understand the logical interconnections among the concepts and develop a metalanguage for critical thinking. This work represents a sophisticated adaptation of the PSTCT for a specific cohort of students and purpose, one geared towards teaching the "whole student" (Ladson-Billings 1995) through an understanding of their specific

cultural context and needs. Further, it allows teachers an access point for applying the theory of critical thinking to pedagogical practice, by providing a common language and useful analogy that represents this theory.

### **3.3 Making an epistemological shift**

As the year progressed, it was clear in the data that the professional development activity was contributing to significant change in how the teachers conceived of the task of teaching for critical thinking. Earlier in the year, teachers who had been working in the program for longer periods of time had demonstrated they were more fluent in discussing the core approach, aims, methods and benefits of the program during interviews. For the two teachers who had been working in the program for longer than a year, this was especially apparent. When asked about what it is like to teach in the program, both demonstrated an epistemology of teaching and learning that focused on the development of students' metacognition, particularly in terms of giving space to student voice, of listening to student ideas and opinions, yet emphasising the development of reasoning and justification, the verbalization of thinking processes and a manifestation of "learning about learning." Both teachers discussed how their views about the program (and by extension, their PCK) had been developed by working collaboratively in professional development sessions to understand and apply critical and creative thinking theory, and sharing practice with other teachers.

By contrast, at the time of the initial round of interviews (June, 2016), another two teachers had been with the program for only two and six months. In comparison to their more experienced colleagues, at this stage of their professional development these teachers tended to revert to speaking about the teaching of critical thinking in terms of the delivery of content. In other words, they had not yet made the shift to considering critical thinking in terms of student thinking, processes and skill, but rather saw it as simply a different type of content to be delivered. One of these teachers described this "content" as "a bit airy fairy, for the want of a better word" and stated that it would be good to have a manual to refer to in order to support teaching practice. The other teacher stated that she still relied heavily on outside resources to support her lessons, especially those used for Direct Instruction, because it was not clear to her how to apply the resources she had received during training. With their focus on the organisation and provision of content and scripted delivery, such resources are not compatible with the intention of the PSTCT and its focus on thinking and the associated student-centred pedagogical imperatives. As such, receiving theory about critical thinking was not enough; teachers also need significant experience using it before authentic pedagogical practices could be developed

The more experienced teachers demonstrated a greater elasticity of mind and were more positive in terms of disposition towards teaching critical thinking. One interpretation of this phenomenon is that over the period of teaching thinking skills, the more experienced teachers had more thoroughly developed their habits of mind. They did not merely deliver educational content related to critical thinking; they had internalised it too. Metacognition, reasoning, inquisitiveness and other dispositions crucial to critical thinking were being developed in the teacher along with the students; it would be bizarre to imagine otherwise. Less experienced teachers who did not initially see the fundamental difference between critical thinking and other types of content, viewed the PSTCT as overly idealistic or perhaps only superficially beneficial. As their experience with the delivery progressed, however, there was a shift in both their attitudes towards and facility with the pedagogy, but up to that point their reactions were indicative of the fact that their current pedagogical practice had been overly concerned with content and direct instruction.

In order to test if these types of epistemological positions could change with time spent on professional development for critical thinking, a follow up interview was conducted with the teachers who were newer at the time of the first interview. The second interview occurred in November, at which time each teacher had been involved in the program for over seven months. The intent was to gauge whether their ideas about the approach and the resources had shifted away from a content-focused, Direct Instructional approach. In discussing her teaching during the second interview, one of these teachers reported that:

*The critical and creative thinking — now that I have done all of the PD ... it is now easy to put all of that into the language you need to use... At first with those resources it seemed like so much information, but now I can go ok, I need that, so speak about that, I can use that, I know how to utilize that in my lessons. Now it's a lot easier...I'm not afraid now if the children do throw a curly question at me, and you can say to them "Wow, I am blown away by what you have just asked me!" That's what we want the students to be able to do... I don't want to spoon feed you, I want this to come from your thinking processes, that inquiry process. Filter through what you already know and how you can relate it... he [the mentor] came here one day and he said what you are doing is giving them a problem to fix that they don't have a tool to fix it with. They have to create that tool...through that inquiry process.*

Thus, at the time of the second interview, this teacher no longer conceived of lessons as being about content delivery. Instead, she had made the shift to thinking about the skills for effective thinking, and how students can practice and demonstrate such skills within the online lessons.

A result of this shift was that she was then better able to use provided materials to support the teaching of such skills. The other teacher who was relatively new at the time of the first interview underwent a similar change of perspective. In discussing impressions of the program, this teacher explained that other teacher friends “think [that teaching in Solid Pathways] is wishy-washy — but we actually have to be more structured and organized.” For both teachers, this shift took seven months of continual practice to achieve, indicating the necessity for ongoing and immersive professional development in which the fundamental bases of pedagogical practice are negotiated.

### **3. 4 Mechanisms supporting ongoing PCK development**

Throughout the professional development activities that were observed in the unit, the inquiry model cycle used to undertake action research provided structure to guide and reinforce ongoing PCK development among the teachers in the unit. This structure allowed for the four mechanisms discussed above to be brought to bear on the process of professional development in such a way that the imperative for epistemological and pedagogical change was supported.

First, the role of theory was embedded in the action research in a number of ways. Using professional scholarly reading was set as a requirement to inform the first and second stages of the inquiry cycle, both in deciding on a problem of practice to address, and in considering how to address it. Further, collegial discussion in these and later phases centered around the approach to student cognition that is emphasised by the PSTCT and how teaching activity in the unit should better address this approach. In this way, the action research activity remained close to the intentions of the theory of critical thinking posited through the UQCTP training. This allowed teachers to make use of the theory in a way that iteratively and continually guided their practice and its development.

Second, the imperative for change required through the third phase of the inquiry cycle focused teachers on both making use of and developing *specific materials* for the teaching of critical thinking. This was seen in teachers being prompted by the action research process to further develop unit and lesson plans and teaching materials that could act as vehicles for the pedagogical practices they wished to improve. It was also seen in the outcome that teachers reported they were better able to put to use the resources provided through the PSTCT, especially the Critical Thinking Matrix and Q-Matrix.

This in turn led to the development of *practical activities* and instructional techniques that teachers could not only trial themselves, but that they could see in use through the

practice of their colleagues, which they had the opportunity to observe through the structured observation and reflection stages of the cycle. This occurred for teachers in providing feedback for each other's lessons, and in similar reflections they produced about their own practice.

This *collaborative activity*, also seen in the team-wide sharing and discussion that occurred in stages one, two and five of the inquiry cycle (when teachers would report on their planning, research, evaluation and findings during staff sessions), established a pattern of collegial collaboration that further reinforced the imperative for pedagogical development, pedagogic reflection and sharing of practice.

We argue that these four mechanisms are necessary for supporting the type of pedagogical development necessary to be able to teach in ways that support student cognition. These mechanisms, along with the structure provided by the action research process, facilitated the extent of pedagogical development that was seen in the unit throughout the year.

## **Conclusion**

The present study constitutes a *prima facie* case for the mechanisms and processes that can support the development of pedagogies for teaching critical thinking. It is clear from this case that the use of the PSTCT and its associated resources provides a useful theoretical basis for the development of PCK for critical thinking. This represents a considerable advance in our understanding of the conceptual resources and training required to assist teachers transform their classrooms into sites of collaborative, critically engaged and inquiry-focused learning. However, no amount of theory will adequately stimulate the processes by which sophisticated and enduring pedagogical practices are developed. Here we see that action research can provide structure to professional development programs and can enable the sustained reflection and epistemological change required for undertaking a shift from a focus on content to a focus on processes of student cognition.

A clear outcome of the study is that in using the PSTCT, teachers themselves benefit from developing the habits of mind that they intend to develop in students, in particular, dispositions towards open-mindedness, metacognition, inquisitiveness and resilience.

While the characteristics of the Solid Pathways unit differ considerably to the normal classroom context, especially in terms of the institutional and curricular frameworks that teachers must work within, this case study offers special insight into the nature of effective

pedagogical development processes when such constraints are reduced or removed. The same mechanisms reported as important by general classroom teachers undertaking PSTCT training were similarly important in the pedagogical development activity in Solid Pathways. This suggests that fundamental issues for developing PCK for critical thinking remain the same regardless of the context for teaching. It is therefore important for those undertaking the kind of pedagogical development described here to consider how to achieve these conditions in their own sites and contexts, with the types of constraints this brings. While pedagogical development for critical thinking is predicated on a basis in theory, independent practice in putting such theory to use, carried out in a culture of collegial collaboration and dialogue is also a necessary ingredient in its attainment.

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