

An Insight into the ‘Balancing Act’ of Teaching

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This paper examines some of the complexities involved in the actual work of classroom instruction by examining interactions among the goals of teaching. The research is part of a case study of teaching a Year 7 Singapore class comprising students of average mathematical ability. Among the complexities of teaching analysed here are the problems associated with trying to fulfil the multiple goals of teaching and the conflict experienced by the teacher as he attempts to carry out these goals. This provides insight into how a teacher performs the act of balancing different goals while carrying out instruction in class. The implications of these insights into teaching practice for the wider education community are also discussed.

The use of metaphors has a long history in linguistics and social sciences. Metaphors are powerful tools that provide information about unfamiliar objects by making corresponding references to familiar representations. The use of metaphors has also featured in the mathematics education research literature. For example, King (2001) used the metaphor of jazz performance, emphasising improvisation as distinctly characteristic of teaching practice. Chazan and Ball (1999) focused on biological fermentation as a metaphor for ideas that “bubble and effervesce” (p. 7) during classroom discourse. The basis for using metaphors to describe and analyse practice is that metaphors “cross the borders between the spontaneous and the scientific, between the intuitive and the formal ... they enable osmosis between everyday and scientific discourses” (Sfard, 1998, p. 4), thus giving them a role in linking theory and practice. If, as has been suggested (Bishop, 1998; Christiansen, 1999), theories are sometimes inadequate in directly reforming teaching practice, then using metaphors that anchor theories to forms familiar to practitioners holds promise. Metaphors “permit us to reason about [the target domain] using the knowledge we use to reason about [the source domain]” (Lakoff, 1994, p. 210). To attract the interest of practitioners and to involve them more closely in the process of knowledge generation, it is helpful to explore metaphors that are easily identifiable with teachers’ instructional work and that reflect the actual problems they experience.

A teacher in the classroom has to attend to many issues — curricular objectives, diverse student competencies, subject content, students’ social conduct, consciousness of time, keeping the class focused, and so on — often simultaneously. There are thus complexities in the teacher’s work along social, cultural, historical, temporal, and intellectual planes (Lampert, 2001). It is thus not surprising that the challenges for a teacher in the classroom include managing dilemmas (Lampert, 1985) and coping with conflicting goals of

teaching — what has been called ‘walking the pedagogical tightrope’ (Wood, Cobb, & Yackel, 1995). The metaphor of an ongoing *balancing act* between competing instructional goals is perhaps an apt depiction of teachers’ struggles with the complexities of classroom teaching.

Although the centrality of this aspect of tightrope-walking in teachers’ work is acknowledged by others (e.g., Ball, 2000; Fleischer, 1995), there is little development in the literature where this metaphor is used to frame the study of the deeper instructional issues faced by teachers as they balance goals. The present study seeks to contribute to knowledge of this balancing act. In particular, it focuses on the complex mix of goals that a teacher brings into the classroom and examines how a teacher negotiates the balancing act of coping with the tensions arising from the interaction among these goals.

This approach of looking at teaching via goals is premised upon the assumption that every teaching action is traceable to one or more goals of the teacher. A significant number of projects and reports from the Teacher Model Group at Berkeley are based on this same goal-based methodology for analysing teaching behaviour (Schoenfeld, 2000; Schoenfeld, Minstrell, & van Zee, 2000; Zimmerlin & Nelson, 2000). The way the goals of teaching are described and viewed in this paper is influenced by the ‘goal-driven architecture’ used by the Berkeley group.

The Research Setting

This research is part of a project investigating the complexities of teaching in a naturalistic classroom context, where the usual constraints of teaching, such as syllabus coverage within stipulated time and limited resources, are taken as givens. The project covered a geometry module of eleven lessons, each of 70 minutes. The class chosen for the study was a mixed gender Year 7 Singapore class of average mathematical ability (mostly 13-year-olds). During the module, students were expected to participate normally in classroom discourse, seatwork, group work, and interacting with computer outputs. They were taught the geometry curriculum requirements of other same-level classes in the school. Further details about school and classroom conventions in Singapore are described later.

During the project, the first author — hereafter referred to in the first person — replaced the resident teacher as the class mathematics teacher. My role was therefore one of both researcher and teacher. The researcher-teacher approach is appropriate since the two ‘roles’ can be intentionally harnessed to fulfil both the work of teaching and the work of research (Wilson, 1995). Prior to this study, I spent the first seven years of my professional career teaching mathematics in school settings to students ranging from Year 7 to Year 12. The last five years of my career have been spent in a university as a teacher-educator and beginning researcher. This account of my professional history clarifies my expertise in teaching and in research. Validity concerns associated with self-studies were addressed by adopting multiple forms of data representation and interpretation (Feldman, 2003).

My teaching actions and thoughts were captured using in-class video and post-class same-day reflections. The reflections were made while reviewing the video-recording, noting, *post hoc*, my account of the thoughts and decision-processes I had undertaken at various stages of the lesson. Other classroom artefacts related to instructional work (e.g., lesson plans, overhead transparencies, computer files, and students' written work) were also collected as sources of data.

My prior experiences in teaching had shaped my beliefs and knowledge of teaching, students, and mathematics. Intensive research has focused on the nature and evolution of beliefs and how they affect teaching behaviour (e.g., Aguirre & Speer, 2000). For the purpose of this study, it suffices to note that researchers agree that such beliefs play a major part in guiding teachers' goals and actions (Ball, 1991; Cuban, 1993; Malara & Zan, 2002). My more recent involvement in research also shaped my teaching goals. The influence of my research experience was in a mixing of theoretical knowledge of mathematics teaching — to which I had easier access in my new capacity as a researcher — with the existing knowledge and beliefs acquired in practical teaching experiences. A specific example of how knowledge of van Hiele theory affected the conception of my teaching goals is explicated in the next section. This amalgam of knowledge and beliefs derived from both teaching and research experiences helped determine my goals for teaching the geometry module.

Identifying the Goals of Teaching

My beliefs about mathematics teaching are both personally-owned as well as built up through perceptions of my social role as a mathematics teacher in Singapore. This socially-influenced character of my belief system must take into consideration the wider schooling culture and the mathematics curriculum in Singapore. In Singapore the education authority centrally determines the school mathematics curriculum. Although schools vary slightly in the actual topics covered at each year level, the practice of teachers following a sequence of topics governed by strict time frames is the *modus operandi* across all schools. When I took over the class from the resident teacher for the eleven geometry lessons I felt it was my professional responsibility and hence an instructional goal to complete teaching what the school had originally expected.

Another factor affecting school mathematics teaching is assessment. In Singapore, the school and society place heavy emphasis on students' outcomes in examinations. I saw it as my responsibility to teach students mathematics in a way that would prepare them for impending tests and examinations. This translated into a teaching goal, where I aimed to teach skills, procedures, and techniques directly relevant to helping students tackle examination-type questions.

To me, however, teaching geometry is not merely about covering syllabus content and preparing students for examinations. I feel that mathematics teaching should develop students' ability to make deep meaning of what they are able to do on the surface. Indeed, the syllabus document itself states that one

of the aims of mathematics education is that it should enable students to “appreciate the power and structure of mathematics, including patterns and relationships” (Ministry of Education, 2000, p. 9). In the context of geometry teaching, this means fostering students’ abilities to provide geometrical explanations for spatial phenomena. I want to encourage students to think in increasing degrees of geometrical abstraction.

Students’ progression in geometric thinking can be modeled in terms of van Hiele levels. As these are now widely known in the literature, only a brief outline is given here (further details are in Clements & Battista, 1992; Gutierrez & Jaime, 1998; Hoffer, 1983; van Hiele, 1986). Students who recognise geometrical objects only by shape and gestalt features are operating at the “Visual” or “Recognition” level. When students can view a geometric object as a holder of properties, they enter the “Analysis” stage. Students who can make deductive relationships among properties are said to have reached the higher “Ordering” or “Relational” level. At the “Deduction” level, students construct formal mathematical proofs. The van Hieles also proposed a further level beyond the scope of secondary geometry. Seen through this framework of the van Hiele theory, one of my goals for teaching geometry was to help students progress towards higher levels of geometric thinking.

Quite apart from social, political, and discipline-related influences, I also have a personal belief that sustains my interest and motivation in teaching. This belief is that all students in my class are able to do mathematics in the sense that each can attain the basic level required by the curriculum. When expressed as a goal of my teaching, it would be that I strive to teach every student according to his/her abilities, especially helping the less proficient ones to achieve the basic levels prescribed in the curriculum.

A summary of my goals for teaching geometry follows:

- G1. To cover the geometry content allocated within the time frame given by the school;
- G2. To prepare students to tackle exam-type questions from the topics within the geometry module;
- G3. To help students progress to higher van Hiele levels of geometric competence; and
- G4. To help *every* student meet the curriculum objectives.

The presentation of these teaching goals in a list is not to suggest any order of priority. More significantly, I do not suggest that they are easily separable when observing actual teaching behaviour. In practice, classroom events may fulfil one or more of the goals all at once. Also, the goals may not be independent of one another, since the fulfilment of one may support or hinder the fulfilment of others. The actual interaction between the goals during practice is a complex one, and the delineation of my teaching goals in point-form is partly for ease of reference. There is also no claim of comprehensiveness in the list of goals presented; these goals are those I perceive to be directly related to the teaching of geometry.

Wiske (1995) reported on teachers who “defined [teaching] in terms of the

types of problems, taken from their texts, tests, and workbooks ... " (p. 193). This reliance on curriculum documents to guide instruction seems to match the curriculum-driven and examination-oriented focus of my teaching agenda identified in G1 and G2. As to wanting students to meet curricular objectives (G4), Newman, Griffin and Cole (1989) encountered teachers who felt "it is important to find ways in which children can succeed as well as possible in their academic work" (p. 145). Regarding G3, the abundance of literature on van Hiele theory reflects the research community's ongoing interest in these aspects of teaching. Thus, although the teaching agenda that I brought into this study was my own in the sense that it is conceived and implemented by me as the teacher, there is an added sense that the teaching goals are shared and appreciated by a wider group of teachers and researchers who may find these objectives familiar to their own practice and study.

Examining the Goals in Practice

In line with the methodology advocated by the Berkeley group of researchers, I identified the main overarching goals G1-G4 that I brought with me into classroom teaching. The focus is now directed towards examining the complex interaction between these instructional goals.

Teaching the 'Rhombus Problem'

In analysing the video and post-lesson reflection data over the 11 lessons in the study, there was clear evidence of the underlying G1-G4 goals in my actions and thoughts. There were numerous occasions where a 'balancing act' between the different goals was performed. For the purpose of this paper, I will focus on one of these balancing acts in order to unpack the complexities involved when multiple goals interact. To do this I present an instructional episode where the conflict of goals involved the entire mix of goals G1-G4, and where the goal interactions cut across lesson segments of varying 'grain-sizes' — from a short discourse to a few lessons. The chosen episode was during the teaching of the 'rhombus problem' at the beginning of lesson eight.

The 'rhombus problem' came from the textbook and its diagram was reproduced on the board (see Figure 1). It required students to obtain the measures of the angles labelled ' x ' and ' y '. The problem was posed to the class at the beginning of the lesson and time was given to students to attempt the solutions individually in their notebooks. In the two previous lessons, I had taught students the side, angle, and diagonal properties of special quadrilaterals, including rhombuses; here I hoped to apply all these properties to a typical examination item. When I decided to include this problem in my lesson, therefore, my primary goal was G2, as seen in my lesson plan notes:

I begin here [with the problem] because this is what I intended to do in the last lesson but did not quite get to it. This is important in so far as the goal of teaching students how to attempt textbook exercises (in preparation for tests) is concerned.

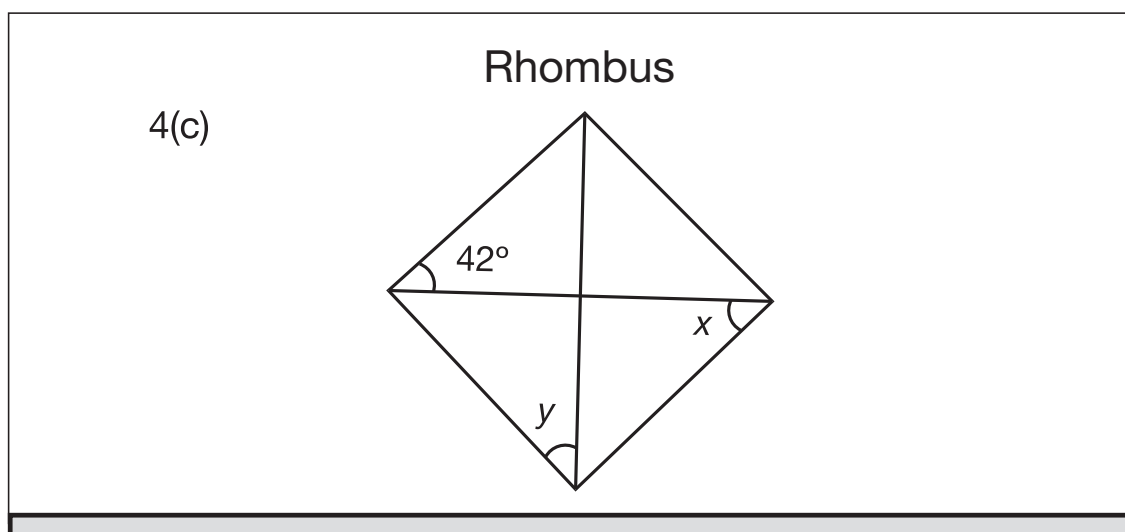


Figure 1. Presentation of the “rhombus problem” on the board

In class, as the students attempted the problem, I walked around to monitor their work and provide guidance when necessary. As I did so, I noted the errors that students made while working on the problem. My post-lesson reflection summarises my observations:

In the question the diagram given was that of a rhombus. But the rhombus looked very much like a square. And a number of them wrongly assumed that the interior angle of the rhombus was 90 degrees. ... So a number of them could not yet see but are just drawn by the appearance of the diagram rather than focusing on the properties.

After looking at the errors in the students’ work, I realised that my original intention of teaching students the correct solution [G2] would not be sufficient, since it would not deal with the students’ mistake of imposing “square” properties on the rhombus. I decided I needed to address their rootedness to the visual form, or help them move beyond a visual-based mode of operation to the “Analysis” van Hiele level. To do this, I needed to incorporate G3 into my subsequent instruction. However, the thought of teaching with G2 and G3 in mind presented an immediate tension. For the reader to appreciate my internal struggles, it is necessary to go beyond the confines of lesson eight to view my broader teaching plan for special quadrilaterals.

Instructional History Prior to the Rhombus Problem

I introduced special quadrilaterals, including rhombuses, in lesson six. In the first section of that lesson, students worked on a prepared Sketchpad template, classifying the different special quadrilaterals shown on screen. Upon opening the sketch, the screen showed six quadrilaterals that appeared to be squares; however, they were each in-built with properties that uniquely matched the respective special quadrilaterals listed. As the students had done a similar

classifying exercise on *Sketchpad* earlier in lesson 5 on special types of triangles, they were familiar with the need to explore each figure by click-and-drag to look for “drag-resistant properties”. Upon dragging, the figures reveal their intrinsic properties. Figure 2 shows how the screen may appear after drag-mode is applied.

After working on dynamic figures of the special quadrilaterals, the next section of lesson 6 required students to draw representations of each of these quadrilaterals using a setsquare (for drawing perpendicular and parallel sides) and a marked ruler. The drawing activity was intended to reinforce students' visual familiarity with each type of quadrilateral, and the use of a setsquare was to help students to begin considering quadrilaterals in terms of parallel and perpendicular properties.

Lesson seven continued the study of special quadrilaterals by shifting the focus from the gestalt view of quadrilaterals to an emphasis on geometrical properties. In the first section of the lesson, students explored separate *Sketchpad* templates featuring a square, a rectangle, a parallelogram and a rhombus. They were told to use the 'Measure' option and drag-mode to observe and conjecture about the side, angle, and diagonal properties of each of these shapes. In the second section of lesson seven, I conducted a whole-class discussion based on the students' observations during the *Sketchpad* activity. The commonly agreed conjectures were recorded on an overhead transparency, projected for the students' reference. This summarised properties about sides (e.g., equality, parallelism), interior angles (e.g, right angles, opposite angles), and diagonals (e.g., perpendicularity, bisection) of the various special quadrilaterals.

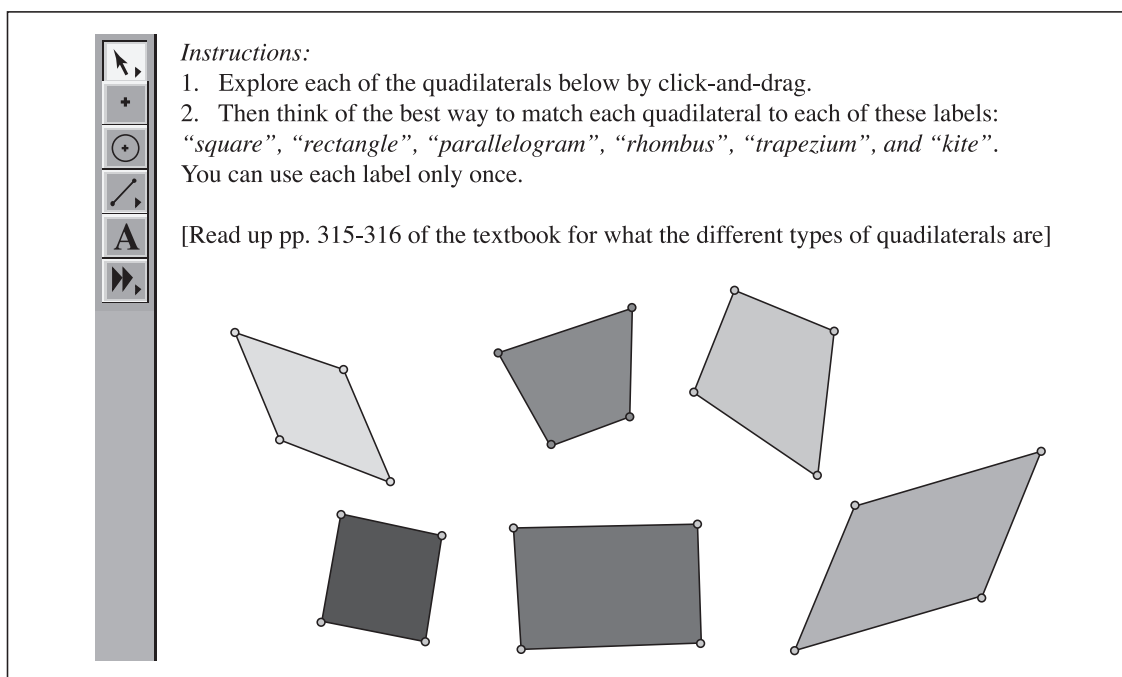


Figure 2. A screenshot of the quadrilateral classification sketch after dragging
(When the sketch is first opened all the shapes appear as squares.)

Re-examining the conceptual development of “rhombus” in lessons six and seven, the reader can see my deliberate attempt to begin from gestalt recognition (the *Sketchpad* quadrilateral classification activity) to a consciousness of parallel properties (in the setsquare drawing task) to a conjecturing of properties by observing each figure (in the *Sketchpad* activity utilising the ‘Measure’ option) to a direct consideration of properties (in the discussion over the summary sheet). That gradual increase of complexity in the instructional activities corresponded to the goal of helping students progress to a higher van Hiele level of geometric competence [G3].

Back to the ‘rhombus problem’ again—and, the balancing act

I now return to the juncture in lesson eight where I experienced the G2-G3 tension. The rhombus problem required that students could operate at the “Analysis” stage with respect to rhombus properties. However, I observed that many students’ responses were still at the lower visual-based mode. My original plan was to teach the solution of the problem [G2], with the assumption that previous lessons had prepared them sufficiently to understand the solution. With this assumption in doubt, my struggle was between proceeding with the planned demonstration of the solution [G2] or taking time to address students’ visually-driven ideas of quadrilaterals [G3]. To do the former would be to teach with the knowledge that a significant portion of the class would be unprepared to appreciate the solution strategy. This would violate my belief in teaching every student [G4]. To do the latter would mean that a substantial amount of time would be taken getting students to re-consider the rhombus beyond merely its gestalt features. This would mean postponing some of the planned components in lesson eight, which would go against the desire to complete the geometry content within the stipulated time period [G1]. Figure 3 represents graphically a simplified version of the dilemma I faced.

Both paths were problematic, as each hindered the fulfilment of some goal. There was no clean solution that would fulfil all the goals satisfactorily, so I had to walk the ‘pedagogical tightrope’ and maintain a balancing act, and make a decision based on what I was aware of at that time in order to continue the classroom instruction. My decision then was to proceed with the original plan of discussing the solutions and in the process do as much as I could — quickly — to bring students to operate beyond the visual-based mode. This approach was not a solution to the problem of conflicting goals; it was merely an attempt to fulfil at least one goal — in this case G2 — while minimising the violation of my other goals.

Having made that decision, I proceeded to discuss the solution of the rhombus problem in a whole-class instructional setting. I began by dealing with the easy part of solving for x , applying the alternate angles theorem. The solution for y , however, was where the students had wrongly assumed that the interior angles were 90 degrees. Instead of going ahead with presenting the correct solution, I wanted to give a short treatment to deal with the G3 problem discussed above. The classroom discourse below shows the approach I took.

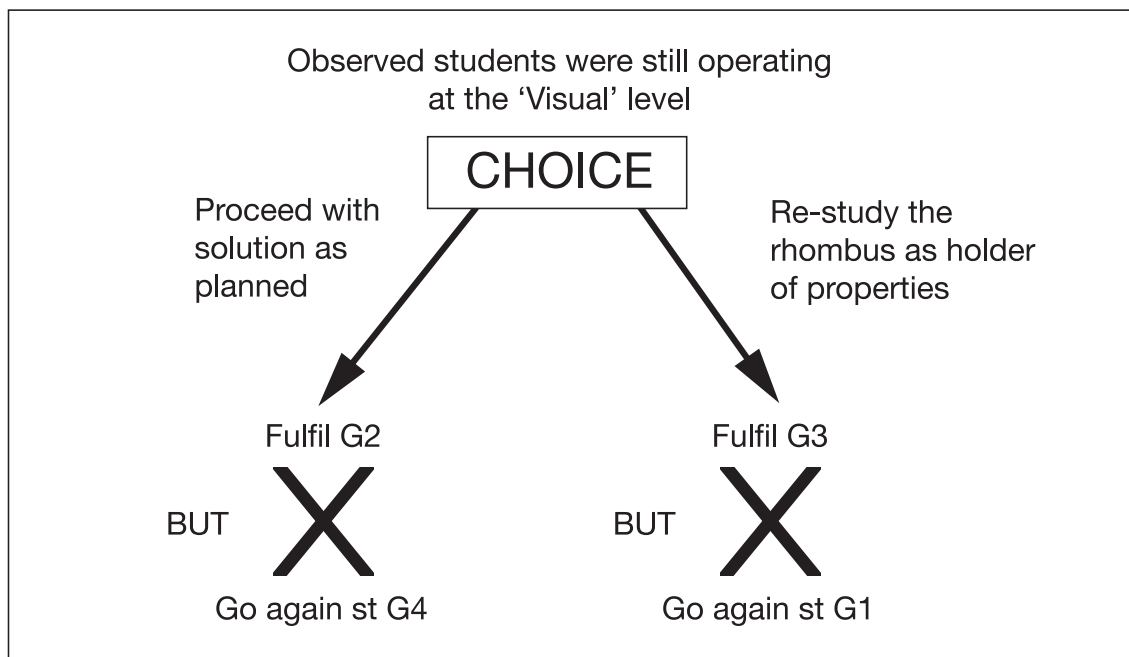


Figure 3. Illustration of goals interaction

Teacher (T): Now the difficulty is in the y it seems, yeah? [smiling] I notice some of you do this. Can Mr Leong put on the board for you to consider? ... Someone suggested that this was 90 degrees [marks one angle with the right angle symbol, then pauses to see reaction]

Farin: Oh it's me.

Wei: [shakes his head]

T: Yes, I saw a few of you do that. Would you have any comments about this [pointing to the right angle drawn]?

Chorus: No.

T: No comments? You agree [with thumbs up]?

Chorus: [A number nodding] No.

T: I saw some yes, some no. Ok. Er ... What is this figure here [pointing]?

Chorus: Rhombus.

T: Does a rhombus have a 90 degrees [pointing to the right angle symbol]?

Chorus: [A mixture of yes and no, with each 'camp' trying to shout the other down.]

Fauzi: May not be 90 ...

I started by highlighting the error that I observed as they solved for y . Instead of telling them the error directly, I posed it as a question for the class to consider. Their disagreement about whether or not that marked angle was indeed a right angle provided a motivation for resolving the conflict. I then drew a rhombus and a square to help those visually-driven students shift their focus to inherent properties of figures [G3, G4]:

T: [Draws using free hand a square-like diagram and a rhombus-like diagram on another side of the board.]

Mr Leong has drawn two diagrams on the board. Can you guess — can you give a name to each of them?

Chorus: [Mixture of “square” and “rhombus”]

T: This [pointing] is a rhombus because — why? — all the sides are equal [marks the equality of the sides on the diagram]. ... And this is a square [pointing]. What is the difference between them?

Hassan: The shape.

Farin: The angle.

T: [nods] This [pointing to the square] is a rhombus-like figure but it has an additional feature, that is, each of the angles are 90 degrees [marks the right angle symbols in each interior angle]. A square must have right angles huh?

Dickvan: Must?

T: Must [emphasis, with repeated nodding of head]. For a rhombus, must [it] have right angles or not [pointing at the interior angles of the rhombus]?

Chorus: No.

By comparing the square and the rhombus, my purpose was to point out that while having perpendicular adjacent sides is a critical attribute of a square, it is non-critical for a rhombus. [This construct of *critical* versus *non-critical* attributes of geometrical concepts is traceable to Vinner and Hershkowitz (1983).] Having made that observation, I returned to the rhombus problem:

T: [Walks back over to the diagram for 4c] You see — though [pointing to the diagram] it looks like a square, but nobody says it is. It says it is a rhombus [pointing to the label “rhombus” written above the diagram].

Chorus: Yeah. [a few students]

T: So can we assume that this is [pointing to earlier right-angle symbol] 90 or not?

Chorus: [A mix of yes and no, with "no" louder and trying to drown the "yes" group.]

At this stage I sensed that despite my explanation there were still some students who remained visually-oriented. However, as discussed earlier, this 'detour' to deal with this problem was meant to be a short treatment. Even though I knew that I did not manage to help all students to understand me then — which conflicts with G3 and G4 — I had to 'move on' with the solution of the rhombus problem.

A Look Back at the Teaching of the Rhombus Problem

This account of my experiences teaching the rhombus problem highlights the fact that the goals I brought into the classroom influenced the way I taught and the decisions I made at various junctures of the lesson. These goals, however, were not equally prominent to me at all points of the lesson. While all of the goals G1 to G4 resided within the teacher consciousness throughout the lesson — as can be seen by how they all sought to 'surface' in the teaching of the rhombus problem — at different parts of the lesson, different goals acquired greater prominence in my teaching. Table 1 illustrates this uneven manifestation of the goals-at-work in teaching the rhombus problem.

Table 1
Overview of the experience teaching the rhombus problem

Section	Sequence of teaching experiences	Goals involved
1	When I started by presenting the drawing of the rhombus on the board, my primary purpose was to teach a way to solve a typical textbook problem.	G2 at the fore
2	The students' mistaken view of the rhombus as a square triggered thoughts about the need to move their mental operational focus away from being visually-based to one that is property-based.	G3 needs to be addressed
3	This G2 vs G3 conflict led to further tensions regarding use of time and the need to help every student learn.	Tension widens to include G1 and G4
4	My solution to the dilemma was to give a short treatment in correcting the error, reserving the time primarily for solving the problem.	Partially address G3 and G4; Primarily G2

Discussion

This paper has sought to examine the nature of the 'balancing act' when teachers try to incorporate multiple goals in teaching. Like tightrope walkers, I juggled many goals of teaching at the same time and maintained deliberate constant monitoring of how those goals interacted. I made improvisations along the way to cope with emergent goals that, in turn, added to the challenge of balancing. Unlike performing tightrope artists, however, I was not always successful at balancing all the goals throughout the act of conducting the lesson. There were junctures where I needed to compromise one or more worthy goals because the conflicting nature of the goals made it impossible for me to fulfil all the goals simultaneously. Despite careful planning beforehand to carry out those goals in practice, the actual occurrences during classroom instruction produced situations that caused some goals to appear in competition with each other. Those conflicting priorities posed serious challenges to the work of teaching. Nevertheless, at points when I needed to suppress some goals, it was not to abandon the whole act; rather, the giving up of a goal was to allow other goals to be met so that I could still proceed with the lesson. At those moments of decision, I weighed the instructional options and prioritised according to the needs apparent to me at that time.

Like the tightrope walker, I also drew on resources to help me with the act. But unlike his more tangible resources — such as a balancing pole — most of my balancing tools were mental resources often undetectable to an observer. Throughout the balancing act I used the knowledge of instructional history with the class, the awareness of students' errors, the judgement of their abilities to learn the properties of rhombuses given a short time, and the constant monitoring of the instructional situation as internal resources to help me evaluate the decisions I had to make. These resources in the thought world, though hidden from direct view, played important roles and were evident in the instructional choices I made.

Thus, if I hazard a guess at how an observer who imposes his/her own goals and assumptions would evaluate my teaching during lesson eight, he would likely spot 'areas of weaknesses' such as my decision to proceed with the rhombus problem despite the observation that not all students were able to see the perpendicularity of adjacent sides as a non-critical attribute. However, such a view does not take into account the other competing goals I had in mind and my need to prioritise them amidst their complex interaction. Hidden from the direct scrutiny of this classroom observer were all my inter-goal struggles that are closely tied not only to the immediate demands of instruction but also to the wider time scope of instructional development with the class. Thus, judgements or conclusions drawn from observations of acts of teaching alone may not necessarily do justice to the teacher's work. To understand why a teacher chooses to take a particular course of action in class, there is a need to take into account the goals behind the actions, the history of goals implementation, and the problems of implementing these goals given practical constraints such as time limitations, syllabus coverage, preparing students for examinations, and others.

In my teaching of the rhombus problem, it would be more informative if a hypothetical post-lesson discussion with the observer was not merely about my actions in class, but also on the goals underlying my actions. Such a dialogue might shift the focus from whether my actions were 'right' or 'wrong' to exploring better ways to perform the balancing act amidst multiple goals.

In the introductory section of this paper, I suggested exploring a metaphor of teaching that can capture the contextual richness of practice as well as possess the potential to advance discourses about teaching. Such a metaphor can potentially attract both researchers and practitioners into collaboration in theory-building about practice and hence encourage a move towards the bridging of the theory-practice gap. From the analysis of the 'balancing act' metaphor, the nearness-to-practice part of the requirement is largely satisfied. The metaphor, when seen in the context of the underlying goals that are being balanced, also accommodates pluralistic theoretical stances. A look at the goals G1-G4 will reveal that either a behaviourist or a constructivist framework fits within the goals structure. By admitting both of these theoretical streams, the metaphor encourages cross-disciplinarity and provides a platform for more theoretical orientations to enter the discussion about the teaching enterprise.

Conclusions

The description of my attempt to teach the rhombus problem highlights the particular challenges of balancing the goals that are more directly associated with the teaching of geometry. While the goals of teaching that I explicated are mine in the sense that they are owned by me, they are nevertheless also shared by a wider community of teachers insofar as they can identify with these goals in their own practices. Teachers have been voicing their concerns about the multiple demands of teaching and the need to prioritise competing objectives. This paper provides a snapshot of the nature and the realities of the struggles they face. The problem of coping with teaching goals is an experience shared by practitioners in the classroom. There is thus a need for a re-examination of the teaching enterprise in a way that takes into account the complexities involved in the 'balancing act' that teachers perform from day to day.

References

- Aguirre, J., & Speer, N. M. (2000). Examining the relationship between beliefs and goals in teacher practice. *Journal of Mathematical Behavior*, 18(3), 327-356.
- Ball, D. L. (1991). Research on teaching mathematics: Making subject-matter knowledge part of the equation. In J. Brophy (Ed.), *Advances in research on teaching (vol 2): Teacher's knowledge of subject matter as it relates to their teaching practices* (pp. 1-48). Greenwich, CT: JAI press.
- Ball, D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. In J. Bana, & A. Chapman (Eds.), *Mathematics education beyond 2000* (Proceedings of the 23rd annual conference of the Mathematics Education Research Group of Australasia, Vol. 1, pp. 3-10). Sydney: MERGA.

- Bishop, A. J. (1998). Research, effectiveness, and practitioners' world. In A. Sierpiska & J. Kilpatrick (Eds.), *Mathematics education as a research domain: A search for identity. An ICMI study* (pp. 33-45). Dordrecht: Kluwer Academic Publishers.
- Chazan, D., & Ball, D. L. (1999). Beyond being told not to tell. *For the Learning of Mathematics*, 19(2), 2-10.
- Christiansen, I. (1999). Are theories in mathematics education of any use to practice? *For the Learning of Mathematics*, 19(1), 20-23.
- Clements, D. H., & Battista, M. T. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 420-463). New York: Macmillan.
- Cuban, L. (1993). *How teachers taught: Constancy and change in American classrooms, 1890 – 1990* (2nd ed.). New York: Teachers College Press.
- Feldman, A. (2003). Validity and quality in self-study. *Educational Researcher*, 32(3), 26-28.
- Fleischer, C. (1995). *Composing teacher-research. A prosaic history*. Albany, NY: SUNY Press
- Gutierrez, A., & Jaime, A. (1998). On the assessment of the van Hiele levels of reasoning. *Focus on Learning Problems in Mathematics*, 20(2), 27-46.
- Hoffer, A. (1983). van Hiele-based research. In R. Lesh, & M. Landau (Eds.), *Acquisition of mathematics concepts and processes* (pp. 205-227). Orlando: Academic Press Inc.
- King, K. D. (2001). Conceptually-oriented mathematics teacher development: Improvisation as a metaphor. *For the Learning of Mathematics*, 21(3), 9-15.
- Lakoff, G. (1994). What is metaphor? In J. Barnden & K. Holyoak (Eds.), *Analog, metaphor, and reminding (Advances in connectionist and neural computation theory Volume 3)* (pp. 203-258). Norwood, NJ: Ablex.
- Lampert, M. (1985). How do teachers manage to teach? Perspectives on problems in practice. *Harvard Educational Review*, 55(2), 178-194.
- Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven, CT: Yale University Press.
- Malara, N. A., & Zan, R. (2002). The problematic relationship between theory and practice. In L. D. English (Ed.), *Handbook of international research in mathematics education* (pp. 553-580). Mahwah, NJ: Erlbaum.
- Ministry of Education (2000). *Mathematics Syllabus Lower Secondary*. Singapore: Author.
- Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in school*. Cambridge, UK: Cambridge University Press.
- Schoenfeld, A. H., (2000). Models of the teaching process. *Journal of Mathematical Behavior*, 18(3), 243-261.
- Schoenfeld, A. H., Minstrell, J., & van Zee, E. (2000). The detailed analysis of an established non-traditional lesson. *Journal of Mathematical Behavior*, 18(3), 281-325.
- Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 27(2), 4-13.
- van Hiele, P. M. (1986). *Structure and insight*. Orlando, FL: Academic Press.
- Vinner, S., & Hershkowitz, R. (1983). On concept-formation in geometry. *Zentralblatt fur Didaktik der Mathematik*, 83, 20-25.
- Wilson, S. (1995). Not tension but intention: A response to Wong's analysis of the researcher/teacher. *Educational Researcher*, 24(8), 19-22.
- Wiske, M. S. (1995). A cultural perspective on school-university collaboration. In D. N. Perkins, J. L. Schwartz, M. M. West, & M. S. Wiske (Eds.), *Software goes to school: Teaching for understanding with new technologies* (pp. 187-212). Oxford, UK: Oxford University Press.

Wood, T., Cobb, P., & Yackel, E. (1995). Reflections on learning and teaching mathematics in elementary school. In L. P. Steffe, & J. Gale (Eds.), *Constructivism in education* (pp. 401-422). Hillsdale, NJ: Lawrence Erlbaum Associates.

Zimmerlin, D., & Nelson, M. (2000). The detailed analysis of a beginning teacher carrying out a traditional lesson. *Journal of Mathematical Behavior*, 18(3), 263-279.

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