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How Teachers use Formative Assessment Strategies during Teaching: Evidence from the Classroom

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Abstract: Using lesson observations, the study reported in this article explores how two practising secondary mathematics teachers implemented formative assessment actions in their classroom teaching. The study also investigated whether teachers' beliefs about teaching and assessment could be mapped onto their classroom practices. In particular, while the two teachers were implementing student portfolio assessment in their own Year 9 mathematics lessons, the classroom observations focused on how they utilised formative assessment actions such as clarifying and sharing learning criteria intentions and criteria for success; activating students as instructional resources; and, providing feedback that moves learners forward. The findings suggest that one of the teachers made better use of formative assessment or assessment for learning actions while the other showed an emerging understanding of such ideas. A holistic analysis of teachers' actions point to possible links to their beliefs about teaching and assessment. These findings imply that some teachers may hold productive beliefs about teaching and assessment that support the use formative assessment actions more readily. Such productive beliefs provide a useful platform for enacting better assessments inside secondary classrooms, given that there is paucity of research that deals with how secondary teachers make use of formative assessments. The findings implicitly confirm that better use of formative *assessment strategies tend to result in more interactive lessons.*

Introduction

Assessment in education has generally reflected a "measurement-driven" approach that serves purposes such as ranking students and keeping schools accountable (Watt, 2005; Popham, 2014; Carless & Lam, 2014; Wyatt-Smith & Klenowski, 2014). With changes in our understandings about how children learn, these assessment methods have been challenged (NRC, 2000, 2001, 2005; Popham, 2014; Blackburn, 2017). For example, the sociocultural approach to learning challenges the significance given to measurement-driven assessments (Smith, Hill, Cowie & Gilmore, 2014 Heritage 2014; Earl & Timperley, 2014; Cowie 2005; Willis & Cowie, 2014) and calls for a need for a change to different types of assessment techniques (Wyatt-Smith, Klenowski & Colbert, 2014; Popham 2014; Looney, 2014; Murchan & Shiel, 2017). Formative assessments, or assessments for learning, often capture many other varieties of assessments that

teachers design and use. Formative assessment is an umbrella term that includes a variety of actions undertaken by teachers and/or students which provide information that can be used as feedback to guide teaching and learning (Black & Wiliam, 1998). A further requirement proposed by Cowie and Bell (1999) is that such assessments be implemented during the teaching and learning process.

A precursor to using formative assessments in the classrooms is the significance of a change in teachers' beliefs about teaching and assessment (Marshall & Drummond, 2006; Smith et al., 2014; Brown, 2018). According to Philipp (2007, p. 259), beliefs are "lenses that affect one's view of some aspect of the world". For example, teachers' beliefs affect their assessment related actions. As such, some teachers tend to re-enact the teaching as well as assessment behaviours of their own favourite teachers (Smith et al., 2014). In the Fijian classroom context, teachers generally teach and assess mathematics using traditional approaches. This is problematic because such an approach is likely to narrow down the curriculum and deny learners opportunities for active learning and engagement with higher-order mathematical processes such as problem solving and mathematical reasoning.

The main aim of this study was to explore how two teachers implemented formative assessment actions in their classroom after going over a two-day professional learning intervention in developing and enacting portfolios as a means of classroom assessment. A related aim was to explore if there existed any relationship amongst teachers' beliefs related to mathematics teaching and assessment and their classroom actions related to formative assessment. In order to explore this, it was seen as important to first investigate teachers' beliefs about mathematics teaching and assessment. Pursuing these research aims, the study sought to answer the following research questions: What are Fijian secondary mathematics teachers' espoused beliefs about teaching and assessment? When provided with support, how well do teachers utilise formative assessment strategies during teaching? To what extent do teachers' beliefs about teaching and assessment align with their classroom practices? The study is important because the Fijian mathematics lessons are generally teacher-centered and teachers rely heavily on traditional forms of assessments, such as written examinations. Therefore, exploring teachers' beliefs and knowledge about contemporary forms of assessment amidst a context dominated by traditional teaching and assessment practices will help us better understand teachers' assessment related beliefs and practices, and how assessments could be used to improve student learning (Brown, 2018; Bonner & Chen, 2019). According to Brown (2018, p. 7), teachers' conceptions matter because they help teachers "filter and guide their interpretation and implementation of assessment." In addition to this, previous research on formative assessments remains ill-conceived and there is a need to have more research on how formative assessments can contribute to "specific instructional situations and settings" (D'Agostino, Rodgers & Karpinski, 2000). The current study aimed to look at how two teachers applied formative assessment techniques in their mathematics lessons.

After a brief review of the theoretical underpinnings of the study, the literature on beliefs about teaching and assessment is presented. This is followed by methods, results and discussion of the findings. The final section concludes by presenting recommendation for further research.

Theoretical Orientation of the Study

In this study, we were guided by the socio-cultural understanding of teaching and assessment. According to Cobb, sociocultural theorists seek to "investigate the participation of the *individual-in-cultural-practice*" (Cobb, 2007, p. 22; emphasis in original). Because sociocultural theorists see learning as deeply embedded in established, historically transforming cultural practices, this study saw merit in using this theory to gain a deeper understanding of formative assessment *in action*. Cobb (2007) states that while sociocultural perspectives have much worth, mathematics education researchers have not exploited this fully. However, a number of researchers in the area of formative assessment have shown much interest the sociocultural approach. For example, Willis and Cowie (2014) see assessment as a method of "generative dancing". The authors view learning and assessment as embedded in the cultural practices of learners. Learners tap on explicit and implicit forms of knowing from their sociocultural settings in order to successfully participate.

When learning is viewed as participation rather than a wholly cognitive task, our notions of what fits as evidence of learning must also evolve. Instead of trying to see 'inside' a learner's mind to explore his or her thinking processes, teachers must search for information such as how and why students do and do not interact with opportunities and resources to which they have access. According to Willis and Cowie (2014), assessment for learning is a situated practice in which interaction is very important. This idea is supported by Wyatt-Smith, Klenowski and Colbert (2014) who see assessment as enabling. Teachers must see themselves as choreographers who can harness the socio-cultural understandings that students have. In other words, teachers can use the sociocultural lens to understand students' thoughts and actions. This would be beneficial in terms of understanding the various complexities of learning from a much more situated perspectives of the learners.

Gaining from such insights, the study used the model of formative assessment (or assessment for learning, as is commonly known) suggested by Black and Wiliam (Wiliam, 2007). While there are many other models of formative assessments that are useful in making sense of the nature of formative assessments inside a classroom, such as the ones proposed by Cowie and Bell (1999) or Torrance and Pryor (1998), the current study chose the model proposed by Black and Wiliam because it provided a lens to understand what teachers and students would do in a classroom that had embedded formative assessment actions in a holistic way. While this model has been explored in classroom studies elsewhere, this study used this model to look into the Fijian classroom teaching. The study's methodology was inspired and guided by this model. This model has five formative actions:

(a)   clarifying and sharing learning intentions and criteria for success
(b)   engineering effective classroom discussions, questions, and learning tasks that elicit evidence of learning
(c)   providing feedback that moves learners forward
(d)   activating students as instructional resources for one another
(e)   activating students as the owners of their own learning (Black & Wiliam, 2009, p. 4).

Implicit in these five categories is what Wiliam (2007) calls the 'big idea'– which is about teachers and learners adjusting their actions in order to meet the needs of the learners. This 'big idea' notion of formative assessment was useful for this study because we were interested in how the two teachers and their students used information to adapt to their learning needs. Wiliam (2007) proposes categories that seem closely intertwined, although the categories are stated

explicitly. For example, engineering effective classroom discussions would only be possible if learners knew the learning intentions and the criteria for success. Furthermore, effective discussions would be expected to result in some kind of feedback, received either from peers, the teacher, or the learner him or herself upon self-evaluation and reflection. Similarly, activating students in self-assessment or peer-assessment would not happen in isolation. While such formative practices are commonly used in other countries, these strategies are yet to be practiced widely in the Fijian education context due to reasons such as cultural ones. For instance, the Fijian culture places importance on mature adults as teachers whose role is to teach and assess, thus downplaying the significance of young learners as active participants in learning and assessing.

The formative assessment framework that this study chose to employ utilizes three of the key actions suggested by Black and Wiliam (1998): *clarifying and sharing learning intentions; providing feedback; and activating students as instructional resources*. It would be reasonable to assume that the other two (engineering effective classroom discussion and activating students as owners of their own learning) would be implicit in the three categories already chosen. The researcher was of the view that it would be helpful if '*activating students as instructional resources*' is stated prior to '*feedback*' because one of the ways in which students would get feedback is through activating themselves as instructional resources for one another. This is not meant to indicate that learning will take place in such a linear manner. The reason *feedback* was placed at the end is that it represents that 'big idea' suggested by Wiliam (2007). These distinctions in the categories were used where possible. However, at times when the distinctions were blurred, the analysis of data focused on the one 'big idea' suggested by Wiliam (2007).

Literature
Beliefs about Teaching Mathematics

Teacher beliefs about how to teach mathematics affects their teaching (Speer, 2005, p.364). Past studies in this area can be categorised into two. The first category of research provides a descriptive analysis of mathematics teachers' beliefs about teaching and learning (Nisbet & Warren, 2000; Beswick, 2006, 2012; Boz, 2008; Ly & Brew, 2010). Beliefs about learning and teaching cannot be separated because teachers' beliefs about one is often reflected in the other. The other category of studies has focused on understanding the relationship between teachers' beliefs about teaching mathematics and their classroom practice (Boz, 2008). After presenting a short analysis on categories of teacher beliefs, a discussion on some of the studies examining relationships between beliefs and classroom practice is presented.

As explained by Nisbet and Warren (2000), two approaches to classifying mathematics teaching are common: a 'transmission' approach and a 'constructivist' approach (p. 36). The transmission approach "reflects a classroom environment that is dominated by timed tests, with little hands on experience and little consideration of the relationship between mathematics and the real world" (Nisbet & Warren, 2000, p. 40). This is similar to the traditional view of teaching (Boz, 2008). The constructivist view (Nisbet & Warren, 2000) or non-traditional view (Raymond, 1997; Boz, 2008) includes teaching mathematics with many real life and hands-on experiences, with lots of interaction between students (Nisbet & Warren, 2000).

In discussing the links between beliefs about mathematics and classroom practices, Nisbet and Warren (2000) note that the relationship, if any, between beliefs about mathematics, beliefs about teaching mathematics, and the classroom practice of teachers is a complex one.

They argue that this relationship is dynamic, with each belief influencing the others. For example, teachers' practices could be shaped by their beliefs about mathematics and teaching mathematics. On the other hand, classroom practice, in turn, could influence teachers' beliefs. That is probably why some studies, including seminal work such as that of Thompson (1984) and Lerman (1983), point out some connections between teachers' conceptions of mathematics and their classroom practice, whereas others show inconsistencies (Boz, 2008; Speer, 2005). Beswick (2012, p. 129) stressed that "teachers are unlikely to have beliefs that fit neatly in a single category." For example, a teacher can employ one belief in one context and another in another context (Beswick, 2012). On the other hand, Speer (2005) argued that some of the inconsistencies in outcomes of studies relating to teachers' beliefs could be due to the inappropriateness of the methodology used in investigating teachers' beliefs. In another study, Beswick (2012) explored teachers' beliefs about the nature of school mathematics and mathematics as a subject. Sally, who was an experienced teacher in the Beswick (2012) study held beliefs about teaching that were more inclined towards a "student-centred" view of mathematics teaching. The other teacher, Jennifer, held no ordered beliefs about mathematics teaching and learning as she was "yet to decide whether a traditional approach or a more inquiry-based teaching approach was most effective in terms students' mathematics learning" (Beswick, 2012, p. 140) and this was closely reflected during her actual classroom teaching.

While there is some evidence of parallels between teachers' espoused beliefs about mathematics and their classroom practice, a few studies such as Raymond (1997) have suggested otherwise. However, there is a general acceptance that beliefs are a useful part of teachers' attitudes and practices (Koehler & Grouws, 1992; Thompson, 1992). According to Mcdonough and Clarke (2005), while some teachers are more aligned to the constructivist model of teaching, a considerable number of teachers appear not to have remained with an authoritarian, transmission style of teaching (Mcdonough & Clarke, 2005). Against this backdrop, this study of Fijian teachers aimed to explore the area of beliefs further by including a new category on assessment-related beliefs of practising teachers. A short literature on assessment-related beliefs is presented next.

Beliefs about Assessment

While there has been ample research on teachers' beliefs of mathematics and its teaching, comparatively little of this has been in the area of teacher beliefs of assessment in the context of secondary mathematics. G. Brown and colleagues have been at the forefront of such research (see for example, Brown 2003; Brown 2004; Brown & Hirschfeld 2007; Brown, 2018). The authors used the term 'conceptions' to refer to what is called 'beliefs' in this study. They identified the following four ways in which teachers view assessment. The first view links to 'assessment for learning'. In this regard, improving student learning is the major purpose of assessment. This can be done by giving effective feedback and involving learners through actions such as self- or peer-assessments.

Harris (2008) explains that the next two belief areas identified by Brown (2004) are linked to assessment actions known as assessment of learning. Such beliefs are associated with actions such as making students be responsible for their own learning or gaining the required certification or holding teachers and schools accountable for student learning. The final area of teacher beliefs rejects the notion of assessment and argues that there is no valid use of

assessments in the education system. Under this view, assessment is seen as unreliable and undesirable (Brown, 2003; Brown, 2004; Harris, 2008). Brown (2004) argues that teachers may simultaneously hold multiple conceptions of assessment. For example, teachers in his study in New Zealand held a conception of assessment for improving teaching and learning as well thinking of it as a means of holding schools accountable. Similar findings have also been revealed in studies such as Hui and Brown (2010), Dayal and Lingam (2015, 2017), Dayal, Lingam, Sharma, Fitoo and Sarai (2018).

Teachers conceptions of assessment are important because different conceptions have the potential to result in different assessment practices (Vandeyar & Killen, 2007). For example, an educator will use assessment as in important part of his or her teaching if he or she views assessment as useful method of gathering information about teaching and learning. In addition, those who value the accountability conceptions might use assessment to hold learners accountable for their own learning. Educators who view assessment invalid and not useful will probably avoid formative assessment (Vandeyar & Killen, 2007). Some evidence of this relationship can be gathered from classroom studies such as that of Marshall and Drummond (2006). The authors conclude that the beliefs which teachers hold about learning will impact their classroom practices related to assessment for learning.

It can therefore be argued that teacher conceptions of assessment is an area worth exploring. As suggested by Marshall and Drummond (2006), bringing positive changes in teachers' assessment related practices is quite challenging. The authors also speculate that teachers' beliefs about learning and assessment seem to provide a useful lens to view how teachers take up formative assessment actions in the classroom. As Nisbet and Warren (2000) pointed, there is a dearth of research studies on teachers' beliefs about the purposes of assessment. Again, this paucity is more evident when it comes to secondary mathematics teachers' beliefs because most of the existing studies have utilized pre-service teachers or primary teachers. Apart from exploring teachers' beliefs about assessment, the current study also explored the plausible links between teacher beliefs and their classroom practices related to assessment for learning.

Contexts and Methods

The researcher worked with two Year 9 classes that do not have to sit for high-stakes national examinations. This decision was made because year 9 classes are less pressured and this makes conducting research with these classes more possible. The Fijian secondary education system places a lot of emphasis on examinations. Examinations at upper secondary level, that is, at Year 12 and 13 serve selection purposes, with those who succeed continuing to the next levels of education. There have been repeated calls from the Ministry of Education (MOE) for schools to target a one hundred per cent pass rate in all national examinations.

This research was conducted in three interrelated phases of which two phases (phase one and three) are described in detail in this section. Phase one of the study included one-to-one interviews with 13 secondary school teachers. The purpose of the interview was to explore teachers' beliefs about teaching and assessment. In addition, the interviews also gave information on teachers' previous experiences in dealing directly with portfolios and formative assessment.

In phase two, these participants took part in a two-day professional learning intervention about how to develop portfolio assessments for their Year 9 class. During this professional learning, the participants were introduced to the idea of formative assessments and ways in which they could use these ideas while implementing portfolio assessments. All the participants liked the idea of portfolios as a means of assessment (Dayal & Cowie, 2019).

In phase three, two of our participants were followed in a series of classroom observations while they implemented portfolio assessments. Short interviews were also conducted post lesson observations. There were seven lesson observations done in total. This final phase of the study, combined with phase one interviews with the two teachers, is reported in this paper. The specifics of the research methodology are presented below.

Research Participants

The participants in the study reported here were two practising secondary school mathematics teachers, Gavin and Jenny (Pseudonyms used). Gavin, a teacher at Marau College, had been teaching mathematics at the secondary school level for the past 19 years, the current year being his 20th year of teaching. Gavin had a Diploma in Education majoring in mathematics and basic science from the Fiji College of Advanced Education. Gavin's lessons were observed on four separate occasions, with each observation lasting for approximately 30 minutes.

Jenny, a teacher at Kaivata College, had been teaching mathematics at the secondary school level for the past 6 years. Jenny had a Bachelor of Science degree majoring in mathematics and science. She had also completed a Post Graduate Diploma in Mathematics. Jenny's lessons were observed on three occasions with each observation lasting approximately 30 minutes.

The individual interviews regarding beliefs about teaching and assessment were conducted a few weeks prior to the professional learning intervention. For the implementation phase of the study, the case study teachers were selected based on their espoused beliefs. They were also nominated by their respective Heads of Department, and both voluntarily agreed to take on that role. The two case study schools were purposively selected for the larger study (Dayal & Cowie, 2019). The two teachers were not known to the researcher prior to the study. The two teachers implemented portfolio assessments in their respective schools approximately two weeks after the professional learning intervention. Prior to the commencement of this study, ethics approval and permit to conduct research was sought from the researcher's university and the Fijian Ministry of Education respectively.

Instrument

In order to elicit teachers' beliefs about teaching and assessment, the study used prompts during one-to-one interviews, as recorded in table 1

Beliefs about Teaching	Beliefs about Assessment
How did you learn mathematics? In your view, what are some of the (best) ways in which students learn mathematics? Which scenario is more important in mathematics teaching and learning: View 1 –Understanding that 5 x 23 = (4 x 23) + (1 x 23), or View 2 - Understanding that finding the cost of 5 apples at 23 cents each involves calculating 5 x 23, and knowing a way of doing it.	Think of the term Assessment. What comes to mind? What is the main purpose of assessment? What are some other purposes?

Table 1: Beliefs Questions

The interviews with Gavin and Jenny took place at their respective schools and were audio-recorded and transcribed. Each interview lasted for approximately 30 minutes.

Data Analysis

Interview data from phase one of the study were analysed using three broad categories or themes derived from literature and these beliefs are represented in table 2. While the broad categories of traditional and constructivist have been used widely to describe beliefs about learning and teaching, they offered a useful lens to analyse teachers' beliefs about assessment as well. The researcher was aware that the two categories of beliefs may not be mutually exclusive. This meant that teachers could hold mixed beliefs. The beliefs framework is in table 2.

Types of beliefs	Beliefs about learning and teaching mathematics	Beliefs about assessment
Traditional beliefs	Skill mastery, passive reception of knowledge, individual learning. Content-focused with an emphasis on performance, teaching of facts with a transmission view	Tests and examinations that focus on facts. Assessment for accountability
	Autonomous exploration of own interest, questioning, discussing, and negotiating	Various modes of assessment. Assessment improves teaching and learning.
Constructivist beliefs	Learner-focused Active construction of knowledge	

Table 2: Data Analysis Framework for Teachers' Beliefs

In order to derive understanding of classroom observation data in the implementation phase of the study, the study utilised three out of the five formative assessment strategies offered by Wiliam (2007). When analysing the audio recordings of the lessons, the researcher paid particular attention to how Gavin and Jenny offered opportunities in their respective classrooms for the following formative assessment actions: clarifying and sharing learning criteria intentions and criteria for success; activating students as instructional resources; and, providing feedback that moves learners forward. These categories are reflected in the analysis of their classroom teaching summarised in table 3 below. Both Gavin and Jenny taught the same topic to their respective Year 9 Classes, although lessons observed differed slightly. The participants were aware that portfolio assessments were to be implemented as an assessment *for* learning activity, and not to be used as a means of summative evaluation of students' learning.

Results
Teachers' Beliefs

Gavin and Jenny's beliefs about teaching and assessment are summarised in Table 3. Gavin held strong constructivist beliefs about teaching and assessment. In other words, Gavin held a view of learner-centered teaching using various means of assessing student learning. Jenny, on the other hand, held strong traditional beliefs about teaching, but agreed with View 2 of teaching for understanding. This meant she showed some evidence of constructivist beliefs. When talking about assessments, Jenny's interview revealed that she held strong beliefs in favor of assessment of learning.

Teacher	Beliefs about Teaching	Beliefs about Assessment
Gavin	Constructivist Beliefs – Learner focused, with active construction of knowledge where learners explore, question, discuss and negotiate learning. Strongly favors View 2 of learning and teaching mathematics. (Example – "I think students need a lot of hands on experience while doing mathematics"; learning mathematics becomes meaningful when we use hands on activities involving maths, for example, "we had to do a buy and sell when learning money, or we had cups of water when learning volume." View 1 was "quite abstract as it was not dealing with anything real, so if students are introduced to view 2, they can then relate to view 1")	Assessment improves learning Various modes of assessment (Example – "Assessment tells me how I have done as a teacher…I have to re-do or re-design my class and take another approach"; "Assessment means more than tests".) Gavin was able to discuss other purposes of assessment such as how assessments could help him re-shape his teaching. "I have to re-look if students have not given me the answer I expected. I have to do that again or do something else."
Jenny	Generally Traditional Beliefs– content focused, with emphasis on completion of tasks and passing of examinations. However, she also favors View 2 of teaching mathematics as well, showing a glimpse of constructivist views when asked about the teaching and learning scenario. (Examples that support traditional beliefs – "I learnt mathematics by doing lots of practice examples and exam questions. In my class I use a lot of examples from past year examination papers because this is what students need to learn". "I teach mathematics by doing short notes and formulas" and "doing more questions" When asked why she thought this type of learning was effective for her class, she responded that following steps was the best way to learn, and that doing of past year examination questions helped them (students) pass mathematics.)	Ranking and grading roles of assessment, using single (testing) mode of assessment. (Example – "Test given to see how much students have learnt…it is an activity to grade the students"; "to find out how much students have mastered". Jenny, was unable to list any formative purposes of assessment. In her view, all purposes of assessment were summative in nature. Excerpts from Jenny's interview are shared below: Researcher: In your view, what is the major purpose of assessment? Jenny: To test the students' ability, to assess students and to know how much they know. Researcher: Can you think of any other purpose? Jenny: To pass exams and go to higher level? Researcher: Any others? Jenny: Ummm…to see which students are, I mean good at which particular field, and whether they are supposed to go to tertiary institutions.

Table 3: Summary of Gavin and Jenny's Espoused Beliefs Related to Teaching and Assessment

Implementation of Portfolio Assessment
Gavin's Case

Gavin's Year 9 class had 42 students with 20 males and 22 females. The classroom organization was traditional – students were seated in rows and columns of two, to accommodate the large class size. A large blackboard and a teacher's table dominate the front of the room. Year 9 students (14 – 15 year olds) are fresh from the primary schools – this being their first year of secondary schooling. In describing how Gavin went about his teaching, at the same time figuring in the concept of portfolio assessment, we use the categories of formative assessment suggested in the proposed framework.

Clarifying and Sharing Learning Intentions and Criteria For Success

By the time of the first lesson observation, Gavin he had already introduced the concept of portfolio assessment to his students, so that they would be undertaking it as part of the topic 'Measurements'. In his recap of portfolios, he focused on the important features such as 'selection of activities to go inside the portfolio', 'providing reasons for selection', and 'writing about what students liked, did not like, understood very well or did not understand well'.

> *In yesterday's lesson we did talk about portfolio assessment (whole class responds 'yes sir'). Portfolio assessment has a few features. The first feature is that you are going to put all your assessments inside your portfolio. The next feature that is very interesting about portfolio assessment is that it is not compulsory to put a particular activity only. For a given topic you will do a few activities and from there, you will choose one…you have the opportunity to pick from those activities…that is one particular strong point about portfolio assessment. The next thing we talked about is that when we pick, we need to have some reasons as to why we pick a certain activity. We all need to reflect on why we picked. After that, you will write a paragraph about what we liked, did not like, understood very well or did not understand well.*

Gavin's comments suggest that he, from the start, had focused his class's attention on formative actions such as 'choose' or 'pick' that would involve students in some kind of self-evaluation. Furthermore, providing reasons for selection and writing personal statements signaled strong relevance to reflective thinking and practice. All of this indicated that Gavin had shared the criteria for portfolio assessment quite clearly, although a closer link to learning intentions could have been included in the selection criteria. This could be noted in students' whole class responses as well. However, at this stage, there was no mention of how the portfolios would be graded. In other words, although students were well briefed on what to do, how their work would be graded was not clear at this stage. Upon asking, Gavin suggested that the typed criteria of success in the form of a rubric had been given out during the previous lesson and students were aware that each item in the portfolio would have equal marks. As the lesson progressed, and upon discussing the learning objectives in detail, Gavin explained how student work would be judged using the marking rubric. The following is part of how Gavin discussed the criteria of success:

> *Before you start the activity, I want you to look at the marking rubrics at the bottom of the activity sheet. You get five points if you have a correct income, all the calculations, and a savings. If you don't have any savings, I can't award you*

five points. That's something you look at before you start……you have one point if
you have a partial budget…you started it but you did not end it correctly.
(Gavin's Lesson Observation 1, 22ⁿᵈ May, 2015)

Apart from sharing the overall criteria on portfolio assessment, Gavin made it explicit in all four lessons what learning intentions he had for his learners. He did this verbally as well as using the blackboard. Although the first quarter of his lesson was normally dominated by teacher talk, his explanations were clear and easy to understand for year 9 students. Instead of writing the objectives on the blackboard only, he focused on breaking down each learning objective into its simplest form using teacher talk situated in real-life contexts. For example, on budgeting, the following discourse was noted:

Gavin: (After explaining the three-column budget format on the blackboard). We
are going to plan a budget for … (pauses and students shout 'class party'). Term
end party that is. What are some of the things you need to do first?
Student: Work out the levy.
Gavin: Yes…Levy means how much you will charge per-person. How will you
work out the levy?
Student: How much money is needed for the party?
Gavin: Yes…depending on that…you will work out how much will be needed.
And that will depend on what you are going to do in the class party. And
depending on all this, you work out a class party budget in pairs. (Gavin's
Lesson Observation 1, 22ⁿᵈ May, 2015)

This discourse makes clear that students were required to 'work out a class party budget in pairs'. Rather than writing the lesson objective on the board, Gavin gave explanations on what the lesson objective required the students to do (budget), and how they would go about doing it (in pairs).

Activating Students as Instructional Resources

During the first lesson observation, Gavin provided students the opportunity to engage in becoming instructional resources. In this lesson, Gavin explained the given learning intentions and the criteria for success for the budget activity. Students then worked in pairs. The students were actively engaged in discussions on budgeting for their term two class party. Gavin walked around the room observing students' work. The following conversation with one pair of students (Livai and Sera) who were busy doing their sums for their budget illustrates how effectively these students could act as instructional resources for one another.

Gavin: (To whole class) It's a form party…I do not encourage you to save a lot
of money.
Sera: (Quickly) That means that we have to cut this amount (Referring to the
$10 Levy). We can cut it down to $6, Sir, because it is too high.
Gavin: (To the pair) It is a large amount and we can't keep it in a bank. We look
at the logic of saving too much. You need to re-assess your levy or you could re-
look at your particulars (expenses) you might increase your expenses. (Teacher
doesn't tell them what exactly to do but gives them two options to choose from.)
Livai: How much are we putting then? (Means what is the revised levy, this
indicates that they will keep their expenses the same but will reduce their levy.)
Sera: $6

Livai: I think put it as $5 (Livai and Sera are both using trial and error method of trying to balance their form party budget.)
Sera: Does some calculations. (Livai participates in doing the calculations as well.)
Gavin: What have you done?
Sera: We cut it to $6.
Gavin: Will you have enough money for the expenses?
Livai: (Unsure yet again.) Can we put it as $7 or $8? (Livai is still thinking of cutting down the levy amount when Sera suggests something different.)
Sera: If we have the money left, can we give it back to the students. (She suggests keeping the $10 levy and returning the surplus of $103 equally among the 41 students once the form party is done.)
Gavin: When you take the money and return it, I think there will be some problems...like people might say there was not enough food or snacks for everyone. The whole idea of this exercise is to plan well so that you don't have more or less.

The above episode informs us that students can come up with a variety of suggestions, although their ideas may not always be mathematically correct. The episode revealed that Livai and Sera were able to 'think out loud' while working in pairs. Their various choices of levy amount revealed a 'trial and error' method of doing things, which could be seen as supporting problem-solving skills. This means students would come up with different answers to mathematical problems using different methods. Implicit, within their conversation is their active participation in a process of self-evaluation and reflective thinking and practice.

Student contributions and questioning also indicate there was a degree of trust between Sera and Livai. In one instance, Sera's telling Livai that she was sure of the levy of $10 made both of them continue with the budgeting plan. The episode indicates the role of a degree of doubt and uncertainty in students' thinking. Livai was not sure about the $10 levy from the start. He suggested different figures at different times. These doubts were important in creating a context where the students acted as instructional resources for one another and Gavin made sure that students worked out things on their own rather than him giving away the correct answers. The above episode is an example of how Gavin used formative assessment action of activating students as instructional resources for one another. The episode points out active pupil to pupil as well as teacher to pupil engagement. Above all, the episode reveals how Gavin allowed pupils to engage with mathematics, in a real life-based context. This example probably reveals Gavin's own past experiences and beliefs of learning mathematics by using 'hands on experience' and utilizing 'questioning and exploring'.

Providing Feedback That Moves Learners Forward

Feedback is one of the core components of formative assessment. In simple terms, it means providing information to learners that would translate into them taking action to understand whatever they could not previously understand. It is different from simply telling the correct answer to the learner.

In each of the lesson observations, Gavin provided varied levels of feedback. As noted in the previous scenario on Sera and Livai, Gavin gave feedback mostly at the task level (It is a form party and I do not encourage you to save a lot), and at the task processing level (Will you

have enough money for the expenses? The whole idea of this exercise is to plan well so that you don't have more or less.) This type of feedback was also noticed in another lesson observation with different paired male and female students (Jay and Kala) working on simplifying a ratio of watermelon to water.

> Kala: Watermelon to water. (Read out the line from the activity question.)
> Jay: Watermelon is 200 and water is 100 (While Kala writes down the numerical expression.)
> Kala: So the ratio would be 200:100. (Kala writes as she speaks.)
> Kala: So in order to find a ratio in its simplest form, we need to find a number which goes into both these numbers. What are the factors?
> Jay: Factors? (Looks confused)
> Gavin: Can you explain what have you done so far?
> Kala: We have written both numbers as (200:100).
> Gavin: Well, that's okay. But what do you do now? Can you think of the highest common factor?

As Gavin moved around the class, he continued to provide feedback about the task as well as feedback focusing on the processes that could help students complete the task at hand. Gavin provided some degree of feedback targeted at self-regulation during the process of selection of entries for the portfolio. In one of the short conversations with the researcher after a lesson observation, Gavin shared his story on how students were selecting which entry to submit. He said that he had asked students to look at their work and decide for which entries they had worked hard and or produced work they were satisfied with, and which entries they liked the most. Such feedback could be especially useful in building a learner's self-confidence about his or her work. In one of the lessons, he gave feedback information to the whole class regarding selection of portfolio entries:

> You will decide on which entry to choose and place in your portfolio. Remember the criteria we have set for decision making. An activity where you have put in a lot of hard work; an activity which you enjoyed doing; an activity which you could write about; an activity that you felt happy about. Those are the criteria you need to look at. You need to select each entry as we go. Remember, the second entry is due tomorrow morning. (Gavin's Lesson Observation 2, 3rd June, 2015)

In Gavin's final lesson observation, while encouraging students to do their short test corrections, he tried to motivate his class to use feedback information:

> This is the final entry for your portfolio assessment. This entry is not only about the test, but also about doing your corrections. I will give you half mark from the total mark available for each correction. For example, if you have got 2 marks worth of questions incorrect, I will give you half of that, which is 1 mark, if you submit a correct answer in your portfolio. (Gavin's Lesson Observation 2, 10th June, 2015)

In this case Gavin was trying to make formative use of a summative test by engaging students in test corrections. In all the interactions, the researcher did not note Gavin giving feedback targeted at the individual self. However, on occasions he did give feedback as "good" or "excellent" during his whole-class teaching, which according to Hattie & Timperley (2007) appears to be the least effective type of feedback. Overall, it could be said that Gavin had

provided appropriate feedback at all levels and had utilised the formative assessments actions well during his teaching.

Jenny's Case

The classroom organization was similar to Gavin's classroom set up, the only difference being that there was more space in Jenny's classroom given a relatively smaller class roll. Jenny's Year 9 class had 27 students with 12 males and 15 females. Although the same topic was under study, it was not possible to observe exactly the same lessons in Gavin's and Jenny's classrooms.

Clarifying and Sharing Learning Intentions and Criteria for Success

In the first class observation, Jenny went straight into the portfolio assessment handout which she had earlier distributed. She began the class by asking the class to refer to this handout. She asked, 'Has anyone done any research on what a portfolio is?" The class was generally quiet and one student replied: "A file where we put all our assessments". Then Jenny told the class that the topic on which they will be assessed using a student portfolio was Measurements. Her introduction to the portfolio assessment was quite ordinary as captured in the following words:

> Five different assessment criteria are given. We will do each one as we go. The first is a budget. Next is hire purchase. Three is a group activity. Four is a short test. Five is a personal story. I will give you a file and you will put each of your portfolio assessment in the file each week. (Jenny's Lesson Observation 1, 18th May, 2015)

From this lesson observation, it could be inferred that Jenny was more focused on the content of the portfolio. Her introduction to portfolio assessment had incidents of her getting into the details of budgeting or hire purchase, as if she was teaching a lesson on budget and hire purchase. Nevertheless, at times, she did focus on students reflecting on their learning. She said, "What have you done, what did you like the most? What good things did you come across, and what things did you not like or understand well– you will need to put this in your reflection". However, she did not mention things such as writing a short paragraph for each entry. Her idea of reflection was linked to a separate entry number five given in the portfolio assessment criteria. Furthermore, her discussion on portfolio assessment did not include anything on 'students selecting a given activity' from a number of activities they would have done. In two other lessons, it was evident that Jenny was too focused on the content of the portfolio and she failed to begin her lessons with a short episode of sharing the learning criteria explicitly to her class, and explaining what the criteria for success would be for each entry in the portfolio assessment. For example, in the lesson on test corrections, she said, "Yesterday, I gave you the correct answers" and "I want you to do your corrections in this class". In summary, Jenny did not make the learning criteria explicit, both for her individual lessons, and also for the overall portfolio assessment, in a manner suitable for her class to get a clear picture of what was going to be involved. Jenny's focus on 'content' of the portfolio and 'correct answers' while doing corrections with students aligns well to her personal beliefs about teaching mathematics.

Activating Students as Instructional Resources

In all three lessons, this element in Jenny's teaching was observed as emerging. Although in her second lesson observation she had set a group activity on 'family budget', there was a lot of chaos in terms of getting the groups organized and in getting the students to work together. One of the reasons could have been that her class activity on family budget was not well thought through. For example, she gave one scenario of parents' income to all the groups, and worked out the total income herself on the blackboard. From there, she left students to decide how the family would spend the total income. Students worked in groups of five. It could be said that the group work was nothing more than preparing a 'shopping list', and students were not involved in any deeper mathematical thought. The idea of having five students in a group was not working out well as students were calling out their own suggestions to go in the 'shopping list'. The following exchange was recorded:

> *Jenny: You have got a total income of $250. How will you spend it?*
> *Student 1: Food*
> *Student 2: Rice, oil (stating quantity in kilograms and litres)*
> *Student 3: (states some more items)*
> *Student 1: No, that's enough for the food.*
> *Student 2: Transport, bills?*
> *Student 1: $20 for transport and $50 for the bills.*
> *Student 3: That adds to $134.*

Unlike Gavin's lesson on preparing a class party budget, this episode revealed how Jenny's students were merely listing items and learning how to add the items. Once they found that their expenses fell below the total income, each student suggested ways to increase the expenses, such as 'movies' or 'dinner out' in order to get a closer figure. The budget activity could have been organized in a better way so as to engage students in more meaningful mathematics. In the other two lessons, there was not much evidence of the teacher activating students as instructional resources for one another in meaningful ways.

Providing Feedback that Moves Learners Forward

It could be noted from Jenny's work that her view of feedback was more about 'telling' rather than giving any feedback focused on the task. Because she was unable to generate effective classroom discussions, as seen in the episode discussed above, her feedback was mostly focused on task (giving answers to the whole class) or the self (saying remarks such as 'good'). She tried to maintain authority in her class, and only a select few would ask her any questions or would respond to her questions. In the lesson observation diary notes from the 22nd May classroom activity on budget, the following observations were noted: "Family budget scenario is given in the handout. Teacher works out income on the blackboard. Teacher lists some examples of expenses on the blackboard. Teacher even does a sample budget on the board. Teacher answers most of her questions herself".

Another example of a lack of feedback in her lessons was related to the third classroom observation on 'test corrections'. The following narrative account sums up Jenny's ways of providing feedback:

> *Yesterday, I gave you the correct answers. What was the answer for question 1*
> *(students respond by calling out 'C'); number two (students call out 'A');*

number 3 (students call out 'B'); number 4 (students call out 'C'), and number five (students call out 'D'). Right! Those are the correct answers. If you have got any wrong, do your corrections. Do your corrections now.

In the above episode, Jenny seems to be interested in only the correct answers. She called out the correct answers and then asked students to do their corrections. She could have involved students in more meaningful ways of doing test corrections, for example, by asking students to provide explanations on why they circled the incorrect choice in the five multiple choice items. In other instances, she would ask students questions such as "do you have any questions class?" or "anything else class?" Such questioning unfortunately did not lead to any meaningful feedback to the students. In summary, Jenny generally failed to develop effective teaching and learning scenarios that could provide the medium for eliciting useful information, which then could be provided as feedback to students. One of the reasons could be that Jenny seemed too focused on the coverage of content, and the completion of the portfolio assessment. Another reason could be a lack of pedagogical content knowledge as revealed in implementation of the budget activity. From her lesson observations, it can be said that the portfolio assessment was not fully integrated with the classroom teaching and learning, and student activities were not well implemented at the classroom level.

Discussion

Gavin's case represents the first example of consistency between a teacher's beliefs and his or her classroom practice. In mathematics education literature, however, this is not a new finding. Previous studies have shown varying degrees of consistency (Thompson, 1992; Beswick, 2006) or varying degrees of inconsistencies (Raymond, 1997). What appears to be valuable in this research is the added dimension of 'assessment beliefs'. Previous studies had investigated teachers' espoused beliefs about the nature of mathematics and their classroom practices. In this study, a dimension of teachers' beliefs about how to assess mathematical learning was included, together with beliefs about teaching. The findings from Gavin's case study suggest consistency between teachers' beliefs about teaching and assessment. These beliefs seem to be reflected in Gavin's classroom practices. Gavin espoused constructivist beliefs about mathematics teaching and learning. He held strong beliefs about assessment *for* learning as well. These two beliefs were constantly reflected in Gavin's teaching and assessment practices. His classroom practice reflected what his espoused beliefs were. Gavin's case is comparable to Angela's lesson in the Marshall and Drummond (2006) study. The authors argue that Angela's lessons were based on the spirit of assessment for learning that reflected a "high organization based on ideas" (p. 137) where the main aim was promoting student learning.

Jenny's case is another example of consistency between a teacher's beliefs about teaching and assessment, and their classroom practice related to assessment. Jenny believed that mathematics is best learned (and taught) using traditional approaches. During the initial interviews, she showed no understanding of assessment *for* learning, while showing strong views towards testing. In her classroom, she found difficulties implementing formative assessment using the criteria suggested by the Black and Wiliam (1998). Based on the Marshall and Drummond (2006) classification, Jenny's practice resembled the 'letter' of assessment for learning and lacked the true spirit of formative assessment. While Jenny and

Gavin both attended a two-day professional learning intervention on formative assessments, Jenny showed an emerging understanding of implementing formative assessment actions in her classroom. Gavin, who was more experienced than Jenny, had utilised formative assessment actions well in his teaching.

Conclusion and Implications

The first aim of this study was to explore teachers' beliefs in relation to teaching and assessment. Gavin held constructivist beliefs about both dimensions. Jenny, on the other hand, held mostly traditional beliefs about assessment. She showed glimpses of constructivist beliefs about teaching, but these were predominantly overshadowed by her traditional beliefs. This study noted consistency between teachers' beliefs about teaching and their beliefs about assessment. The findings reassert the important role of teachers' beliefs in filtering and shaping their actions (Brown, 2018). However, given that the study involved only two teachers, it is difficult to comment on what factors lead to teachers holding different beliefs. As pointed out by Brown (2018), teachers' beliefs about assessment are influenced by the curriculum and the social norms within which teachers work. However, the current study notes that both the teachers held different beliefs about assessment even though they worked within a formal examination system.

The second aim of this study was to explore how well do teachers utilise formative assessment strategies during teaching. The findings suggest that Gavin made very good use of formative assessment actions in all lessons that were observed. The episodes from Gavin's lesson confirm that Gavin was able to utilise these formative assessment strategies with much ease. Jenny's lesson on the other hand, showed glimpses of formative assessment strategies. On some occasions, it seemed that Jenny was struggling to strike a balance between her personal beliefs and experiences about effective teaching and use of assessment strategies such as questioning and feedback and the professional learning acquired during the learning intervention. Jenny's actions in the classroom reflected her beliefs about teaching and assessment. Jenny's beliefs about teaching were dominated by actions such as 'doing lots of practice examples and exercises' in order to 'pass examinations'. Gavin's assessment practices align well with teachers' practices in New Zealand where there is a strong desire to identify students' learning needs and act upon these needs. On the other hand, Jenny's practices seem to be associated with Confucian approaches to learning, where formal tests are seen as a legitimate method of assessment (Brown, 2018).

The final aim of the study was to explore the relationship between teachers' beliefs and their classroom practices. Classroom practices of the two teachers were explored using formative assessment strategies proposed by Black and Wiliam model of formative. This model proved useful for the current study because it is intertwined with elements of good teaching and assessment. The findings suggest possible links between teachers' espoused beliefs and their classroom practices related to assessment. In terms of the relationship between beliefs and practices, it must be noted that such findings are subject to obvious limitations that any case study approach presents. The relationship is based on two case studies and limited classroom observations and is by no means intended as generalisable. In addition, portfolio assessment was a new idea for both Gavin and Jenny. Whatever understanding of portfolios they had accumulated was through a two-day professional

learning intervention. Both had no prior experience with portfolio assessment. The findings of this study are only intended to pave a way for further exploration, given that the relationship between beliefs about assessment and classroom assessment practices is an area in need of further investigation, given the relative importance placed on teachers' beliefs.

The findings also suggest that portfolios can support assessment for learning inside the classrooms. As pointed out by the evidence gathered in our participants' classrooms, mainly in Gavin's case, portfolios provided an opportunity for teachers and students to incorporate the key formative assessment strategies, which may be missing in many ordinary mathematics lessons. Brown (2019; p. 6) claims that assessment for learning is "an insightful pedagogical practice that ought to lead to better learning outcomes and much more capable learners". This study has provided renewed support for this claim.

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