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Introduction

Assessment for Learning (AfL) has been a focus of attention in classrooms in many countries over the last two decades. AfL encompasses everyday classroom processes that enable teachers to gauge their students' current understanding. Teachers then use the insights they gain to tailor their actions and activities to students' learning needs, during the learning process (Assessment Reform Group, 1999; Black & Wiliam, 1998; Black, Harrison, Lee, Marshall, & Wiliam, 2003; Cowie & Bell, 1999; Klenowski, 2009). Deciding how to respond to student ideas in the moment as part of Assessment for Learning planned activities can be challenging for teachers as this vignette and the following analysis illustrates:

The teacher began the lesson by explaining to her class of seven-year-olds that they were going to learn about adaptation and with the overall goal of answering the question, "Why do animals live where they live?" The starter activity was a discussion in small groups about: "Which is the odd-one-out in bird, cat, fish and elephant?" The groups engaged in animated discussion about this question. The teacher then called for answers. The first group answered, "Elephant", to which the teacher responded "No" before she moved onto to ask another group for an answer. Following the teacher's dismissal of the 'elephant' answer, other groups appeared reluctant to answer questions and engage in the lesson.

In this AfL classroom example, the teacher intended to elicit and develop student ideas. In the lesson described above the teacher had planned to stimulate student thinking about animal adaptations by presenting them with animals from distinctly different environments. The teacher expected that the answer to her question would be 'fish' and this was the premise on which she had planned the follow-on activities. However, the animal identified by the first group of students was elephant, which was very different from the teacher's expectations and so she passed over their answer. Student actions following this teacher action indicated that, albeit almost certainly unintentionally, she had provided feedback to the class that she was not interested in student ideas or reasoning per se but rather as a means towards an end she had predetermined. When the children were later asked by the researcher why they had said elephant, they responded, "Well your mum and dad would let you have a bird, fish or a cat as a pet, but never an elephant." Clearly, the students had engaged in reasoning to reach a consensus for their

answer based on their everyday experiences of animals. By not asking for student reasoning, the teacher missed the opportunity to make connections to student learning and redirect student attention to a consideration of animal physical structure and function, and hence assist them to develop one of the ‘big’ ideas of science (adaptation) even though this was her goal.

This example illuminates how teachers face the challenge of noticing these everyday discretionary moments when they are striving to use classroom assessment in the service of learning. Assessment for Learning occurs as part of everyday classroom practice whereby teachers, and students, seek out, reflect upon and respond to information from dialogue, demonstration and observation in ways that aim to enhance student learning, during the learning (Cowie & Bell, 1999; Klenowski, 2009). While teachers can plan a specific activity to create opportunities to make visible what the students are thinking and focusing on, how the teacher responds to this evidence communicates to students what the teacher deems important. A teacher’s response frames what counts as valued learning and determines if and how their actions advance or inhibit student learning and learning motivation. As we can see from the vignette, acknowledging and responding to student ideas is challenging work when it happens as part of planned activities, and it is all the more so when it happens on-the-fly (Harrison, et al., 2018; Shavelson, 2003) or in moments of contingency when student answers are unexpected (Black & Wiliam, 2009; Rowland & Zazkis, 2013). We also included the example in order to direct attention to how a socio-cultural-political framing for what teachers notice and how they choose to respond during AfL may provide a productive way for teachers and researchers to understand and respond to these challenges.

This conceptual paper is therefore as much about what researchers need to attend to when studying teacher AfL noticing and responding as it is about what teachers themselves need to notice for their actions and reactions to be responsive to their students’ thinking, interests and needs in both the short and longer term. Our conceptualisation of learning and assessment is underpinned by a sociocultural perspective which construes these aspects as dynamic situated social processes (Cowie & Moreland, 2015; Gipps, 1999; Harrison, 2006; Moss, 2008; Penuel & Shepard, 2016; Willis & Cowie, 2014; James, 2017). We draw on Mason’s (2002) notion of disciplined noticing to offer a framework for considering how teachers might engage in AfL that

is open and responsive to the productive possibilities of pursuing student ideas as they emerge. Teacher noticing involves two main processes, attending to specific events within classroom interactions, and then making sense of these events within the instructional setting in order to broaden the range of responses a teacher has in their repertoire (Sherin, Jacobs & Phillip, 2011). In order for teachers to attend to evidence of student learning more responsively, this article proposes a framework to support teachers to readily analyse and act on this evidence in a formative way.

We propose three interconnected frames that teachers might use to attend to, make sense of and respond to unexpected events arising from AfL practice, an area of AfL research that has not yet been well explored. AfL research and support for teachers has tended to focus on the design and implementation of formative strategies that teachers can plan to engage students in learning such as sharing learning intentions, identifying success criteria and engaging in feedback conversations with self, peers and teachers (e.g. Black, Harrison, Lee, Marshall & Wiliam, 2003). There are fewer accounts of how teachers respond or take action in-the-moment of AfL interactions, or that explore alternative accounts for student responses that could inform productive actions. Noticing theorists recognise the importance of helping teachers ‘reframe’ their attention to consider new ways of making sense of student responses, as experienced teachers often make sense of disparate pieces of information by drawing on established narratives of meaning, or “story frames” (Erickson, 2011, p. 25 - 26). In this paper, three frames, or ways of accounting for student responses are drawn from emerging directions in AfL research. They include an orientation to the implemented curricula as encompassing a meld of anticipated and emergent ideas and a concern with learning to learn, an understanding of student diversity as a resource, and an appreciation of the socio-emotional dynamics of learning, teaching and assessment. We conceptualise these frames as

1. Curriculum connoisseurship,
2. Cultural and community connections, and
3. Collaborative ways of working.

The frames take account of current political and curricular imperatives that students develop capacities for lifelong and lifewide learning alongside and in addition to mastering the more

traditional disciplinary knowledge, understandings and skills. The frames also acknowledge the diversity in student backgrounds, languages and experiences that is now commonplace as well as understandings of learning as a social practice. To develop the argument for these three frames we explore the relationship between AfL and noticing. Then we argue that the frames provide a manageable and generative framework for teachers to use as they work with students and respond to student ideas during AfL interactions to advance learning.

AfL and teacher professional noticing: Natural partners?

The Assessment Reform Group (1999) introduced the term Assessment for Learning as an elaboration of earlier work on formative assessment (Black & Wiliam, 1998). It is now accepted as an umbrella term that incorporates many aspects of classroom assessment where teachers and learners make use of evidence from within classroom activities to generate feedback to support student learning. Teachers enact AfL through the combination of planned activities and contingent actions and interactions (Black & Wiliam, 2009; Cowie & Bell, 1999). Torrance and Pryor (2001) provide a useful analysis of how teachers focus their attention and make decisions within these two processes. They established that teachers sometimes give consideration to the intended curriculum through what they term convergent formative assessment. Alternatively, teachers may attend to student meaning-making as this unfolds over time, topics and contexts, what they term divergent assessment. Torrance and Pryor (2001) recognise, with others (e.g., Boud, 2000; Penuel & Shepard, 2016), that teachers need to retain a concern with the longer-term goals of a mandated curriculum, while also focusing on what students have to bring to the learning task. As they design through lesson planning and navigate AfL-informed learning pathways teachers need to manage the dynamic between the divergent opportunities that unfold through classroom interactions and the opportunities they design to support student learning of predetermined goals. Torrance and Pryor point out that it is how teachers move in a subtle and responsive manner across this learning landscape that shapes student experience and consequently student learning and affiliation with learning (Willis, 2011). Moreover, while these two orientations of curriculum and student meaning-making map out what is important for ensuring learning and student interest and engagement, they do not help teachers to recognise what is relevant or salient in the moment of interaction (Sadler, 1989). More is required in

helping teachers recognise the dynamics and details of ‘teachable moments’ so they can act on them.

While the adaptive work of teachers has been explained in other fields (e.g. Berliner, 2002; Shulman, 1987) it has not yet been fully conceptualised in AfL research, despite teacher adaptation and teacher noticing and responsiveness featuring in some AfL definitions. The importance of the act of noticing to trigger teacher responsive action is evident in the definition by Black, Harrison, Lee, Marshall and William (2003, p. 10), that “assessment becomes ‘formative assessment’ when the evidence is actually *used to adapt* the teaching work to meet learning needs”. Cowie and Bell (1999, p.32) define interactive formative assessment as: “the process used by teachers and students *to notice, recognise and respond* to student learning in order to enhance that learning, during the learning”. Our proposition is that research on teacher professional noticing has much to offer in understanding how teacher AfL attention and actions are framed in the moment or, as Shavelson (2003) puts it ‘on-the-fly’.

AfL needs to support student learning in both the immediate and longer term and across contexts (Boud, 2000). AfL encourages students to develop greater agency as learners, because it provides classroom activities that generate and reveal student thinking. Importantly, teacher actions need to achieve this for *all* students and not just a select group (Banks, Au, Ball, Bell, Gordon, et al., 2007). This cluster of imperatives ensures that AfL is a complex and demanding process, one in which both teachers and students need to be active and informed participants. Teachers and students together constitute and enact AfL practices as part of the fine-grained social, emotional and intellectual micro-dynamics of the classroom (Hermansen, 2014; Pryor & Crossouard, 2008). The implication for teachers is that they need to be sensitive to opportunities for students to exercise conceptual agency, that is to opportunities for students to treat the concepts, practices and ideas within a discipline as resources that can be adapted, evaluated, questioned, and modified as part of monitoring and progressing their own learning (Cowie, Moreland, & Otrell-Cass, 2013; Greeno, 2006). As the account of learning at the start of this paper highlights, for a teacher to respond productively in the moment, in ways that builds on unexpected or partially formed student ideas, she needs to attend to how students are making meaning. This is necessary for the students to be able to preserve their agency and advance their learning.

There is a substantial body of literature on teacher noticing which focuses on teacher sense making and use of evidence of student thinking as it unfolds (Jacobs, Lamb, & Philipp, 2010). This research values the variation in student ideas and actions (Gibson & Ross, 2016) and the variability in what teachers notice (Robertson, Richards, Elby, & Walkoe, 2015). It also depicts noticing as a responsive act that invites action, which suggests an inclusive, dynamic and purposeful response to evidence of student ideas and interests. For us, the value of Mason's formulation is his focus on noticing as central to being better prepared to choose to respond in the moment creatively rather than react out of habit (Mason, 2002); that is to capitalise on moments of contingency (Black & Wiliam, 2009). Mason (2002) proposes that teachers need to learn to separate their accounts *of* or descriptions of what they notice, from generating possible accounts *for* or explanations of what they notice, so that teachers can consider multiple accounts for why the event may have occurred as it did. Seen this way, noticing supports teacher learning by expanding their ability to learn from their own responsive teaching (Sun & van Es, 2015). This is not a simple task because it requires a mindset for adaptive and responsive teaching coupled with noticing ability and capacity for adaptive teaching actions (Gibson & Ross, 2016). In other words, for AfL teaching actions to be genuinely responsive and adaptive many aspects need to come together to support an outcome of formative action.

Professional noticing research acknowledges that teachers can only attend to some aspects of the learning situation and that they subsequently draw on prior teaching experience (Erickson, 2011) along with specialised discipline knowledge to decide what is salient (Sherin, Jacobs, & Phillip, 2011, see also Sadler, 1989). Mason (2017) makes a distinction between listening-to student responses and listening-for how students are responding, which resonates with Torrance and Pryor's notion of convergent and divergent assessment. Scholars focusing on professional noticing have also directed attention to the need to step outside of the realm of the expert to observe, attend and interpret from the perspective of the learner (Ball, 2011), whilst still keeping an eye on what Ball (1993) calls the 'horizon' of content knowledge. Ball describes this as a kind of 'peripheral vision' or view of the larger disciplinary landscape. Attending to several foci is essential to support students to meet both the immediate and longer term goals of learning. The three frames for noticing and responding as part of AfL that are proposed in this paper are ways

that teachers might use to explore multiple *accounts for* what they notice, as well as provide new ways to give *accounts of* what they notice during AfL interactions. Through consideration of these three frames, teachers will be able to consider different and possibly multiple routes forward to advance student learning.

As Mason and Davis (2013) explain, it is what a teacher is attuned to notice and how they connect what they notice with possible pedagogical actions that is central to teachers to being adaptive and responsive. A focus on professional noticing-for-equity (van Es, Hand, & Mercado, 2017) supports teachers as they make decisions about when and why they might move between convergent and divergent approaches and acknowledge the learner's contribution and role in the process. It enables teachers to make sense of the evidence arising within learning activities by responding to classroom evidence in a dynamic inclusive way. Bringing AfL and noticing research together, provides some insights into how teachers might draw on and incorporate specific discipline knowledge, alongside their knowledge about their learners and learning.

A framework to guide and discipline noticing

The notion of framing provides a means to understand and account for the dynamics of teacher noticing for AfL action. It recognises that teachers have multiple ways of understanding and responding to classroom activity and that teachers prioritise and move fluidly between agendas and knowledge-bases (Horn & Little, 2010; Russ & Luna, 2013; Spillane & Miele, 2007). A frame renders a context meaningful to participants so that they are able to respond to the question: 'What is it that is going on here?' (Goffman, 1974). Our proposition is that when teachers are making sense of student ideas and actions through classroom assessment then a framework that encompasses curriculum expectations, attention to student diversity as a resource, and learning as a social-emotional process is useful. We propose that these three frames embody some of the overlapping pedagogical commitments involved in enacting rigorous, responsive and equitable AfL and that they can help teachers deliberately manage the dynamics of attention and action (Erickson, 2011). Our suggestion is that through their *connoisseurship of the curriculum, making cultural and community connections*, and valuing of *collaborative ways of working* teachers can become more finely attuned to how classroom interactions may lead to productive learning.

Framing teacher noticing for AfL

1. Curriculum connoisseurship as a frame

The curriculum frame relies on teachers' disciplinary connoisseurship. Eisner (1976) describes connoisseurship as an 'apprehension of qualities' that includes awareness and understanding which then informs judgment. Curriculum connoisseurship includes teacher overall curriculum knowledge, discipline knowledge, pedagogical content knowledge, as well as assessment knowledge and capability. It encapsulates the complex blending of knowledge and action needed to progress student learning of the curriculum whilst also developing students' sense of themselves as knowledge-makers and knowers. Teacher connoisseurship of curriculum recognises that different disciplines have different ways of generating, legitimating and communicating knowledge and hence they need to offer different opportunities for students to demonstrate and develop what they know and can do, and for them to access and respond to feedback (Coffey, Hammer, Levin, & Grant, 2011; Cowie & Moreland, 2015). A teacher's curriculum connoisseurship for AfL includes the capacity to assist students to develop expertise in the discipline so that they are able to judge the quality of ideas as members of the guild of knowers (Sadler, 1989). Put another way, it involves teachers in developing student capacity to learn how to learn in a particular domain. Just as importantly, teacher connoisseurship of the curriculum includes them being able to foster students' affiliation with and disposition to continue to learn within a discipline.

To foster student learning through AfL, teachers' need to be able to identify the curricular substance and implications of students' responses. Teachers need to be able to assess whether students' answers are right, wrong or partially right, and to evaluate the extent to which the ideas students express might advance or impede their learning in the short and or the longer term. They need to be able to generate a range of actions to take student learning forward from their current position. Flexibly connected pedagogical content knowledge (Shulman, 1987) is central to this kind of teacher decision-making because it involves understanding how "the subject matter can become part of the experience of the student" (Dewey, 1902, p. 22). Using their knowledge of curriculum, pedagogy and their students a teacher may decide to act in the moment to inform or

extend curriculum knowledge, but he or she may also decide to defer any action, depending on the circumstances.

In the classroom conversation at the beginning of the paper, the teacher's focus was on the scientific concepts of structure and function with the fish as the pivotal example of how animals adapt to their environment. While the teacher was working within a curriculum frame, a more divergent focus might have enabled the teacher to pursue the idea of adaptation to habitat by building on student explanations for any one of the four animals. The teacher might have guided the class to consider how the various and specific features of the elephant, cat or bird helped those creatures survive in the environments where they could be found so that students were primed for the activity she had planned. By asking students why they came to the answer of elephant she could have communicated that the scientific community develops ideas through a reasoning process that is grounded in observation and inference-making, and moved them to a discussion of what kind of evidence is relevant to making a claim in science. That is, the teacher might have productively pursued student understanding of the epistemological grounds of science. Through a more divergent response within the curriculum frame, the teacher in the adaptation lesson might have more productively opened up opportunities for disciplinary learning through their formative actions.

2. Cultural and community connections as a frame

Consideration of students' diverse cultural and linguistic experiences is central to preparing students to capably navigate the flows of power in social institutions, as well as actively participate in their homes and communities (Lee, 2001). When teachers recognise diversity as a resource they can assist students to make links between home and school, which is essential to achieving equitable instruction and equitable assessment (Stobart, 2008). Equitable assessment practices are those that maximise opportunities for diverse students to demonstrate the breadth of their knowledge and abilities in ways that are compatible with their backgrounds. This lies at the heart of the cultural and community connection frame.

This frame directs teacher attention to the funds of knowledge and experience students bring to their learning from their everyday life experiences and from their families and communities as a

resource within and for classroom learning (Gonzalez, Moll, & Amanti, 2005). Teachers can usefully draw on student funds of knowledge in planned AfL activities by connecting the classroom curriculum to them (Glynn, Cowie, Otrell-Cass, & Macfarlane, 2010). Knowledge of the learner's world can inform a teacher's noticing and responses in the moment during classroom events when a student might be drawing on their funds of knowledge from home as a basis for their comments and actions. When teachers design AfL practices that build on student experiences in this way, they can support students to develop their identities as knowledgeable people, and create productive patterns of participation within classrooms (Cowie, 2013; Willis, 2010). By being attentive to this frame, teachers can help students make connections between different cultural, community and disciplinary practices as they draw parallels and discuss nuanced differences.

In the introductory example if the teacher had considered the group's answer through a cultural connectedness framing the teacher could have asked the students to justify their choice of answer in terms of what they knew about these four animals. The teacher would have understood and learned that their choice stemmed from their everyday experience that fish, cats and birds can be pets but elephants are not usual pets. Building on this, the teacher could have drawn students' attention to the fact that different cultures have accounts for differences in animal features. The teacher could then have engaged students in considering what is distinct about a science-way of understanding these differences as well as when, where and why a science-based explanation might be most appropriate. This understanding is important because, as Lemke (2001) points out in relation to science ideas such as evolution changing one's mind "is not simply a matter of rational decision making. It is a social process with social consequences" (p. 301). These links to cultural-disciplinary ways of thinking are necessary for students to be able to recognise and use their science learning in contexts outside those where they were learned, especially in relation to evaluating 'scientific' claims in the media. Teacher attention to these connections holds the promise of increasing the likelihood students will link their school learning with their everyday lives. Moreover, acknowledging students' diverse viewpoints and experiences is a powerful and pragmatic way of enacting a more inclusive classroom for students of all capabilities (Florian, 2007). This may sound straightforward but to do sensitively this teachers have to know their students well, and they need to ensure they do not essentialise or misappropriate student and

community funds of knowledge (Ares, 2011) in their pursuit of curriculum goals. Through the cultural connectedness frame, teacher-student interactions can be fashioned to ensure that each begins to understand the intentions and thinking of the other. This then provides an opening to pursue the reasoning behind the ideas that arise in classroom activities, which in turn will assist teachers in decisions about formative action.

3. Collaborative ways of working as a frame

The collaborative frame encapsulates the teacher's responsibility in fostering a productive learning environment - their developing students as knowledge-makers within the class as a learning community (Brown, Ash, Rutherford, Nakagawa, Gordon & Campione, 1993). It acknowledges the role teachers and students have in co-constructing systems of competence, and in shaping relations of relative authority and belonging for different groups of learners (Hand, Penuel, & Gutierrez, 2012). It also recognises the impact of the culture of a classroom on student opportunities and willingness to demonstrate and dialogue about their learning (Cowie, 2005; Harrison, 2006; Stobart, 2008). Numerous studies have drawn attention to the importance of trust and respect amongst teachers and students and students and students for AfL to flourish (Cowie, 2005; Raider-Roth, 2005). For these reasons teachers need to foster an AfL classroom culture where learning is experienced as a social process and a shared responsibility with students (Marshall & Drummond, 2006, Bourke, 2016). Within this frame the focus is on how teachers can guide learning as a social process and assist students to build the skills and dispositions needed to learn how to learn, and to learn with others (Bransford et al., 2000). Thus, this frame has links back to and overlaps with the curriculum frame as the capacity to collaborate and work within a team has become an explicit curriculum agenda (e.g. OECD, 2017).

Collaborative ways of working grounded in trust and respect, allow student thinking and ways of working to be revealed, developed and revised as their ideas are affirmed, challenged, adopted and adapted. For students some of the benefits are in establishing conditions for productive peer assessment, both as an end in itself and as a scaffold towards independent self-monitoring (Sadler, 2010; Willis & Klenowski, 2017). For teachers, the process of collaborative learning also sets up a chain of evidence as students move through a variety of social contexts that require students to articulate and justify their ideas. As part of this frame, teachers need to ensure that all

their students understand the ‘rules of the game’ for how to contribute to classroom discussions (Pryor & Crossouard, 2008). Importantly teachers can also make decisions about which aspects of the discussion to act on immediately, which to leave for later consideration and which to ignore. Noticing within this frame therefore enables teachers and students to weave evidence of learning together as part of the collaborative endeavour of AfL classrooms.

In the fish example, the teacher initially requested groups to come to a shared understanding and then to offer their ideas. In this way, she was enacting AfL practices of activating peers as resources for learning (Heritage, 2007). However she did not go on to draw on evidence from their discussions or acknowledge they were reporting a shared understanding. Instead, in the whole class discussion the teacher moved from group to group seeking an answer that fitted with her expectations. Within the collaborative frame, the teacher might have investigated student thinking by asking, “Which groups agree with this idea and which don’t?” or “Are there other ideas about the odd-one-out?” She might also have joined the groups together to debate the reasons for their choices, or asked the groups to return to their discussion after they had heard the reasoning from other groups, and evaluate their own reasoning. This would have supported students to develop some of the social skills needed in scientific work where evidence is debated and explored. Instead the teacher’s approach signalled to students that teacher knowledge was of more value in the classroom than student knowledge, leaving students with the expectation that ‘guessing what idea the teacher held in their head’ was the purpose of the activity. Considering evidence through a collaborative frame allows the time and opportunity for students to compare ideas, and therefore provides more evidence for students and the teacher about individual and group understanding. Such an approach enables the teacher to tailor any follow on activities in response to the evidence that signals to individuals and to all the learners that her interest lies in moving their own and other students’ ideas forward, rather than simply searching for correct answers from the class.

Looking back through the AfL noticing framework

AfL as a field has developed through engagement with teachers to develop practice-based evidence of what AfL might look like in action and also how teachers develop their practice (Harrison, 2016b). We have proposed the three frames through which teachers can notice and

respond to student learning, based on our understanding of AfL research and our own empirical classroom studies. Theoretically the frames accord with contemporary sociocultural models for learning and assessment (Gipps, 1999; Moss, 2008; Stobart, 2008). They acknowledge international trends in curriculum development that endorse the need for students to learn how to learn in a discipline in addition to and alongside their learning accepted disciplinary theories and practices. They acknowledge the increased and increasing diversity to be found in classrooms positioning this diversity as a resource rather than an impediment to be overcome. They also acknowledge the situated, social and temporal nature of learning. Our proposition is that, through a multifaceted noticing focus, teachers become more aware of what informs and guides their attention and actions (Erickson, 2011, p. 27). The frames make explicit the multiple foci that teachers often negotiate implicitly, as they seek to enact AfL that encompasses a holistic view of their students as people with ideas and experiences that are relevant to and can enrich the classroom curriculum. The frames enable teachers to attend to their students as people whose learning and knowing is intimately and inextricably entangled in their relations with student peers, with family and with the wider community. In effect the framework supports teachers as they ask:

- What is happening for students' curriculum learning?
- What is happening for students as they navigate between school knowledge and the knowledges and experiences they bring from their communities?
- How are students participating in and developing as knowledge-makers in a learning community?

As we have illustrated with the fish example the insights offered by each frame can enrich teachers' noticing and, subsequently, their opportunities to understand and respond in the moment in a particular context. Juxtaposing the insights from the different frames, allows teachers to make nuanced decisions and to think afresh about how they might respond. For the researcher, the frames allow an insight into the authenticity and complexity of AfL practice, considering AfL as more of a pedagogical process than a teaching strategy that is dependent on how the context, players and interactions shape both the evidence they select, the judgements they make and the actions they take.

When teachers begin to engage with AfL practices, their initial focus is often on eliciting and refining evidence collection during learning activities. Teachers more readily recognise the evidence they expect from their teacher-initiated AfL interactions, in contrast to more informal or student initiated contributions (Hawe & Parr, 2014). However as teachers develop their AfL practices further and explore with students the evidence of their thinking, teachers are able to attend to and a wider range of evidence to inform their formative actions (Harrison, 2016a).

In the narrative at the beginning of this paper, the teacher had planned a peer discussion and questioning activity to elicit student ideas. This kind of activity is a well-recognised AfL practice but for this activity to be an equitable, responsive and formative move, the teacher needed to notice and explore the potential in student answers. Through focusing on noticing using the three frames the teacher might have become aware of alternative entry points to her intended goals for student learning. Alternatively, noticing and exploring the students' curriculum, cultural or social reasoning may have opened up different possibilities for action and learning outcomes. Negotiating across the different frames offers teachers more opportunities for creative choices for formative action rather than a single way forward, but this is also challenging because it involves balancing different kinds of evidence, interpretations and different agendas. A framework provides teachers with resources that can support them to do this challenging work.

Concluding comment

The discipline of noticing is an established field of research that theorises how teachers learn to develop their practice, so they become more sensitive to the implications of student actions and the possibilities for acting creatively in the moment. Mason (2002) outlines this as a systematic process whereby noticing and its development involves consideration of what is deemed significant in a classroom situation, to then make sense of and reason about what is observed by making a connection with and drawing on relevant knowledges. AfL and teacher professional noticing each require a sensitivity to the learning potential of student ideas, actions and interactions. The three frames we propose in this article draw on empirical insights from both of these fields. They provide a conceptual language teachers and researchers can use to articulate and sharpen AfL as a process that takes account of current agendas within curriculum, our understanding of diversity, equity and inclusion, and of the learning process. They support AfL

noticing as a flexible responsive but rigorous process. We know from the noticing literature that without a specific focus, teacher noticing tends to be idiosyncratic (Erickson, 2011). The AfL literature also indicates that when the focus of AfL evidence goes unexamined, some of the richness of student ideas and actions may go unnoticed and opportunities to extend student learning in the moment may be missed. The proposed framework aims to assist teachers in paying more sensitive and sophisticated attention to student ideas and actions that they can then use to inform future instructional decisions.

The AfL noticing frames we have set out necessarily interact and overlap. Ideally their relationship is dynamic and symbiotic, enabling teachers to foreground and focus on different aspects of student learning. The frames may also provide multiple entry and connection points or synergies with other professional learning foci in school contexts. We anticipate they will help teachers gain and develop confidence in their professional noticing and subsequent formative action, as these are often unplanned processes that vary from moment-to-moment, student-to-student and day-to-day. This article draws together AfL research to acknowledge three funds of knowledge - those of discipline based knowledge, knowledge about learners and their communities, and knowledge of collaborative pedagogic approaches, that are all essential in supporting learners through responsive AfL. It highlights the complexities involved in using AfL practices and provides a set of frames around the notion of noticing that can help teachers utilise assessment in a more formative way.

References

- Ares, N. (2011). Multidimensionality of cultural practices: Implications for culturally relevant science education. *Cultural Studies of Science Education*, 6, 381–388.
- Assessment Reform Group (1999). *Assessment for Learning: Beyond the Black Box*. Cambridge University School of Education downloadable from www.nuffieldfoundation.org/sites/default/files/files/beyond_blackbox.pdf
- Ball, D. (1993). With an eye on the mathematical horizon: Dilemmas of teaching elementary school mathematics. *The Elementary School Journal*, 93, (4), 373–97.
- Ball, D. (2011). Foreword. In M. Sherin, V. Jacobs, & R. Phillip (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. xx–xxiv). New York, NY: Routledge.

- Banks, J., Au, K., Ball, A., Bell, Gordon, E., et al. (2007). *Learning In and Out of School in Diverse Environments: Life-Long, Life-Wide, Life-Deep*. University of Washington: Life Centre.
- Berliner, D. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35, 463-482.
- Black, P., Harrison, C., Lee, C., Marshall, B., & William, D. (2003). *Assessment for Learning—Putting it into practice* (1st Ed.). London, England: Open University Press.
- Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education*, 5(1), 7–74.
- Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, 21(1), 5–31.
- Bourke, R. (2017). Liberating the learner through self-assessment. *Cambridge Journal of Education*, 46(1), 97-111.
- Boud, D. (2000). Sustainable assessment: Rethinking assessment for the learning society. *Studies in Continuing Education*, 22(2), 151–167.
- Bransford, J. D., Brown, A. L., and Cocking, R. R., Ed. (2000). *How People Learn: Brain, Mind, Experience, and School*. Washington: National Academy Press.
- Brown, A., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J. (1993). Distributed expertise in the classroom. In G. Salomon (Ed.) *Distributed Cognitions: Psychological and Educational Considerations* (pp. 188-228). Cambridge, UK: Cambridge University Press.
- Coffey, J., Hammer, D., Levin, D., & Grant, T. (2011). The missing disciplinary substance of formative assessment. *Journal of Research in Science Teaching*, 48(10), 1109–1136.
- Cowie, B. (2005). Pupil commentary on Assessment for Learning. *The Curriculum Journal*, 16(2), 137–151.
- Cowie, B. (2013). Classroom assessment: Making space for diversity. In D. Corrigan, R. Gunstone, & A. Jones (Eds.), *Valuing assessment in science education: Pedagogy, curriculum, policy* (pp. 249–265). New York, NY: Springer.
- Cowie, B., & Bell, B. (1999). A model of formative assessment in science education. *Assessment in Education: Principles, Policy & Practice*, 6(1), 101–116.

- Cowie, B., & Moreland, J. (2015). Leveraging disciplinary practices to support students' active participation in formative assessment. *Assessment in Education: Principles, Policy & Practice*, 22(2), 247–264. doi:10.1080/0969594X.2015.1015960
- Cowie, B., Moreland, J., & Otrrel-Cass, K. (2013). *Expanding notions of assessment for learning*. Rotterdam, The Netherlands: Sense.
- Dewey, J. (1902). *The child and the curriculum*. Chicago, IL: University of Chicago Press.
- Eisner, E. W. (1976). Educational connoisseurship and criticism: Their form and functions in educational evaluation. *Journal of Aesthetic Education*, 10(3/4), 135–150.
- Erikson, F. (2011). On noticing teacher noticing. In M. Sherin, V. Jacobs, & R. Phillip (Eds.), *Mathematics teacher noticing* (pp.18–34). New York, NY: Routledge.
- Florian, L. (2007). Reimagining special education. In L. Florian (Ed.). *The SAGE handbook of special education* (pp.7–20). London: Sage.
- Gibson, S., & Ross, P. (2016). Teachers' professional noticing. *Theory into Practice*, 55(3), 180–188.
- Gipps, C. (1999). Sociocultural aspects to assessment. *Review of Educational Research*, 24, 353–392.
- Glynn, T., Cowie, B., Otrrel-Cass, K., & Macfarlane, A. (2010). Culturally responsive pedagogy: Connecting New Zealand teachers of science with their Māori students. *Australian Journal of Indigenous Education*, 39,118–127.
- Goffman, E. (1974). *Frame analysis*. Cambridge, MA: Harvard University Press.
- Gonzalez, N., Moll, L. C., & Amanti, C. (2005). *Funds of knowledge: Theorizing practices in households, communities, and classrooms*. Mahwah, NJ: Lawrence Erlbaum Associates
- Greeno, J. (2006). Authoritative, accountable positioning and connected, general knowing: Progressive themes in understanding transfer. *The Journal of the Learning Sciences*, 15(4). 537-547.
- Hand, V., Penuel, W. R., & Gutiérrez, K. D. (2012). (Re) framing educational possibility: Attending to power and equity in shaping access to and within learning opportunities. *Human Development*, 55(5–6), 250–268.
- Harrison, C. (2006). Banishing the quiet classroom. *Education Review*19(2), p. 67 –77.
- Harrison. C. (2016a). Assessment for Learning in Science Classrooms. *Journal of Research in STEM Education* 1(2), 78-86.

- Harrison, C. (2016b). Adapting pedagogy for formative assessment. *Encyclopedia of Educational Philosophy and Theory*, (pp. 1-5). Springer.
- Harrison C. et al. (2018) Assessment on-the-fly: Promoting and collecting evidence of learning through dialogue. In J. Dolin, R. Evans (eds) *Transforming Assessment. Contributions from Science Education Research, Vol 4*. Springer, Cham.
- Hawe, E., & Parr, J. (2014). Assessment for Learning in the writing classroom: An incomplete realisation. *The Curriculum Journal*, 25(2), 210–237.
- Heritage, M. (2007). Formative assessment: What do teachers need to know and do? *Phi Delta Kappan*, 89(2), 140–145.
- Hermansen, H. (2014). Recontextualising assessment resources for use in local settings: Opening up the black box of teachers' knowledge work. *The Curriculum Journal*, 25(4), 470–494.
- Jacobs, V., Lamb, L., & Philipp, R. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education*, 41, 169–202.
- James, M. (2017). (Re)viewing assessment: Changing lenses to refocus on learning, *Assessment in Education: Principles, Policy & Practice*, 24 (3), 404-414, DOI: 10.1080/0969594X.2017.1318823
- Lee, O. (2001). Culture and language in science education: What do we know and what do we need to know? *Journal of Research in Science Teaching*, 38(5), 499–501.
- Lemke, J.. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching*, 38(3), 296–316.
- Louie, N. (2017). Supporting teachers' equity-oriented learning and identities: A resource-centered perspective. *Teachers College Record*, 119(5), 42 pages.
- Marshall, B., & Drummond, M. (2006). How teachers engage with assessment for learning: Lessons from the classroom. *Research Papers in Education*, 21(2), 133–149.
- Mason, J. (2017). Probing beneath the surface of experience. In E. Schack, M. Fisher & J. Wilhelm (eds), *Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks* (pp. 1-17). Springer.
- Mason, J. (2002). Researching your own practice: The discipline of noticing. London: Routledge-Falmer.

- Mason, J., & Davis, B. (2013). The importance of teachers' mathematical awareness for in-the-moment pedagogy. *Canadian Journal of Science, Mathematics and Technology Education*, 13(2), 182–197.
- Moss, P. (2008). Sociocultural implications for assessment I: Classroom assessment. In P. Moss, D. Pullan, J. Gee, E. Haertel, & L. Young (Eds.), *Assessment, equity and opportunity to learn* (pp. 222–258). New York, NY: Cambridge University Press.
- OECD (2017). *PISA 2015 Results (Volume V): Collaborative Problem Solving*. PISA, OECD Publishing, Paris.
- Penuel W., & Shepard L. (2016). Assessment and teaching. In D. H. Gitomer & C. A. Bell (Eds.), *Handbook of Research on Teaching* (pp. 787–850). Washington, DC: AERA.
- Pryor, J., & Crossouard, B. (2008). A socio-cultural theorisation of formative assessment. *Oxford Review of Education*, 34(1), 1–20.
- Raider-Roth, M. (2005). Trusting what you know: Negotiating the relational context of classroom life. *Teachers College Record*, 107(4), 587–628.
- Robertson, A., Richards, J., Elby, A., & Walkoe, J. (2015). Documenting variability within teacher attention and responsiveness to the substance of student thinking. In A. Robertson, Scherr & D. Hammer (Eds.), *Responsive Teaching in Science and Mathematics* (pp. 227–248). Routledge.
- Rowland, T., & Zazkis, R. (2013). Contingency in the mathematics classroom: Opportunities taken and opportunities missed. *Canadian Journal of Science, Mathematics and Technology Education*, 13(2), 137–153,
- Russ, R., & Luna, M. (2013). Inferring teacher epistemological framing from local patterns in teacher noticing. *Journal of Research in Science. Teaching*, 50(3), 284–314.
- Sadler, R. (2010). Beyond feedback: Developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education*, 35(5), 535–550.
- Sadler, R. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119–144.
- Shavelson, R. J. (2003). *On the integration of formative assessment in teaching and learning with implications for teacher education*. Stanford, CA: Stanford Education Assessment Laboratory .

- Sherin, M., Jacobs, V., & Phillip, R. (2011). Situating the study of teacher noticing. In M. Sherin, V. Jacobs, & R. Phillip (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 3–14). New York, NY: Routledge.
- Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–22.
- Spillane, J., & Miele, D. (2007). Chapter 3 Evidence in Practice: A framing of the terrain. *Yearbook of the National Society for the Study of Education*, 106(1), 46–73, doi: 10.1111/j.1744-7984.2007.00097.x
- Stobart, G. (2008). *Testing times: The uses and abuses of assessment*. London, England: Routledge.
- Sun, J., & van Es, E. (2015). An exploratory study of exploring the influence that analyzing teaching has on preservice teachers' classroom practice. *Journal of Teacher Education*, 66, 201–214.
- Torrance, H., & Pryor, J. (2001). Developing formative assessment in the classroom: Using action research to explore and modify theory. *British Educational Research Journal*, 27(5), 615–631.
- van Es, E., Hand, V., & Mercado, J. (2017). Making visible the relationship between teachers' noticing for equity and equitable teaching practice, In E. Schack, M. Fisher, & J. Wilhelm (Eds.), *Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks* (pp. 251–270). Cham, Switzerland: Springer.
- Willis, (2010). Assessment for learning as participative pedagogy. *Assessment Matters*, 2, 65-84.
- Willis, J. (2011). Affiliation, autonomy and Assessment for Learning. *Assessment in Education: Principles, Policy and Practice*, 18(4), 399-415.
- Willis, J., & Cowie, B. (2014). Assessment as a generative dance connecting teaching, learning and curriculum. In C. Wyatt-Smith, V. Klenowski & P. Colbert (Eds.) *Designing assessment for quality learning* (pp. 23–32). Dordrecht, Netherlands, Springer.
- Willis, J. & Klenowski, V. (2017). Classroom assessment practices and teacher learning: A Australian perspective. In M. Hill & H. Jiang (Eds.) *Classroom assessment for teacher learning: Teachers' experiences and perspectives in the Asia Pacific*. Dordrecht, Netherlands, Springer.

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