Measuring the magical: Leveraging assessment for emergent learning

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Abstract

Emergent learning refers to the unplanned and unexpected learning that can occur through student engagement with complex curricular tasks. In this article, we explore expanded conceptions and practices of assessment that recognise and promote emergent forms of learning. We begin our argument by drawing on complexity thinking to define and position emergent learning within current curricular contexts. We then consider four different approaches to the assessment of emergent learning that work within criterion-referenced frameworks of assessment: (a) ignoring emergent learning; (b) informally celebrating emergent learning; (c) making space to formally recognise emergent learning; and (d) provoking emergent learning. Our article concludes with practical thinking about how we might reconfigure assessments to exploit curricular tasks and assessment processes in ways that simultaneously represent as well as promote emergent learning within classrooms.

The Guitar Sisters

I was recently reminded how the best of teaching intentions can be gloriously overshadowed by the richness, diversity, and complexity of learning.

I instruct a music curriculum course within a faculty of education. To help my students prepare for a career teaching music, I ask them to design and carry out a personal learning project. The purpose of the assignment is for each student to focus on her or his individual music educator identity and growth. I ask: What do you want to know more about and/or be able to do better in order to strengthen your readiness for music teaching?

Rachel decided she wanted to know more about the practical application of guitar pedagogy. She designed a project that involved teaching guitar to her younger sister, Jamie. Rachel prepared a 6-week program for Jamie, documented the teaching process with a video blog, and kept a reflective journal to identify and discuss her own growth and learning along the way.

> In designing the assignment, I had carefully constructed an assessment rubric to measure the achievement of learning goals that I hoped students would work towards. Despite the necessarily varied learning experiences that students experienced, I felt the breadth of my criteria would serve to meaningfully address significant learning. My assessment criteria for the project included, for example, "clarity of personal learning goals and strategies for achieving them", and "thoughtfulness and thoroughness of reflection and connection to professional literature".
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> As I worked through Rachel's submission, I dutifully identified how well she had achieved the various learning goals. Rachel's work clearly fulfilled all the assignment expectations and represented achievement of the pre-determined criteria. I happily awarded her full marks with plenty of evidence to support my judgment. And yet …
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> The learning I identified and celebrated was not the most significant learning that Rachel had encountered. Not at all.
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> As I watched the videos of Rachel and Jamie working, learning, and making music together, I began to recognize that something truly magical was occurring—resonant realisations and deep knowledge development that had nothing to do with anything on my assessment rubric. I observed Rachel learning about her sister, and about her relationship with her sister. It was beautiful—tender, compassionate, and incomparably valuable. Unplanned-for and un-targeted learning brilliantly outshone and mattered more than anything I had expected. This learning happened not quite in spite of me, but certainly beyond anything I envisioned or had made space for in my woefully lacking assessment tool.

The anecdote above draws our attention to unplanned outcomes that can arise from complex curricular tasks. We identify these learning outcomes as *emergent*. Emergence calls on notions of the unpredicted, the generative, the creative; like the magical, emergence happens by surprise and often creates positive learning experiences (Sawyer, 2015). The concept of emergence is elucidated through complexity theories of curriculum. From this perspective, emergence is enacted through a relational curriculum (van Manen, 1991) that brings together self with other, experience with cognition, and past with present in the co-construction of new knowledge. These relationships are productive, generative and, as such, of interest in education. Emergent learning is fundamentally an interpretive and

relational process that "plays a vital role in the continual re-configuration of individual and collective identities" (Davis, Sumara, & Kieren, 1996, p. 167).

The sisters' learning in the anecdote above went well beyond learning to play the guitar and learning how to teach the playing of guitar; it involved relational significance (i.e., self with other) that was deeply personal and enduring. This learning was provoked by and experienced through an artistic curriculum, but we recognise that emergent learning is not confined to the arts. Rather, we venture that emergent learning occurs across and within all subject areas in all kinds of assignments and curricular tasks. The key is for teachers to recognise the potential for this learning, to not stifle it, and ideally, to encourage it. Too often, assessment structures do not fully recognise emergent learning, and worse, limit student learning by inherently devaluing outcomes beyond specifically targeted learning objectives (Linn & Gronlund, 1995; Sheridan-Rabideau, 2010; Torrance & Pryor, 1998). Such assessments reduce the lived curriculum to the measurable curriculum, inhibiting the potential for emergent learning. Our interest in this article is to explore how assessments can not only recognise emergent learning but also encourage it. If the purpose of classroom assessment is to collect evidence on student learning and to represent that learning to students, parents, and other educators (Airasian & Russell, 2008; Popham, 2013), then it is important for assessments to collect evidence on *all* forms of learning, planned and unplanned (Torrance & Pryor, 1998).

Current classroom assessment practices support the use of assessments to monitor as well as promote learning towards predetermined curricular expectations through criterion-referenced forms of assessment (McMillan, 2000, 2008; Popham, 2013). Contemporary assessment for learning (AfL) strategies are emphasised as a way to support students' development towards expectations via ongoing feedback generated by the teacher, peers, and students' self-assessment (Stiggins, 2004; Willis, 2010). Teachers are encouraged to integrate assessments throughout teaching and learning periods, and to connect those assessments to students' individual and collective approaches to learning. Further, AfL encourages peer assessment strategies that motivate a highly dialogical

and participatory learning environment in classrooms (Willis, 2010). As a result of this collaborative, interactional, and responsive approach to teaching, learning, and assessment, student learning is spurred in directions that align with pre-established learning expectations, but can also lead to unplanned, different learning.

Given contemporary purposes and structures of classroom assessment, it is not surprising that learning might emerge beyond the pre-established expectations. Hence, it becomes important for teachers to find ways to recognise and support auxiliary learning (Cowie & Bell, 1999; Torrance & Pryor, 1998). In this article we build on Sawyer's (2015) notion that "assessments should incorporate and reward the sort of deeper conceptual understanding that results from creative learning" (p. 17). We assert that there is a need to expand our conception and practice of assessment to include emergent learning in order to more fully represent the exceptional experiences of growth that students encounter. However, our argument goes further. We also want to consider how assessments can be used to purposefully support and promote emergent learning. This means that assessment structures must make room for the unknown and encourage the kinds of engagement with curricular tasks that lead to emergence.

In the following discussion we explore these ideas further, interrogating the role and structure of assessment as a provocation for emergent learning. As a basis for our argument, we draw on complexity and curricular theories to position emergent learning within current curricular contexts. We then explore different assessment approaches to emergent learning that work within existing standards-based, criterion-referenced frameworks of education. Our article concludes with practical thinking about how we might reconfigure assessments to exploit curricular tasks in ways that simultaneously represent as well as promote emergent learning.

Positioning emergent learning

Drawing from complexity understandings of curriculum, emergence refers to the co-construction of new knowledge through experiences that join self with other, body with cognition, and past with present. Davis, Sumara, and Kieren (1996) explain that learning in classrooms:

> emerges from an understanding of human existence and cognition—to borrow a term from post-Darwinian evolutionary theory—as processes of natural drift in which human subjects co-emerge with the environments which contain them. Because these environments are always the sum total of all the historically effected interactions which comprise them (human and nonhuman), they function in a circularity of existence in which what is new evolves from what is old and, at the same time, what is old is modified (re-structured) by what is new. (pp. 166–167)

The authors further suggest that emergent learning cannot be preplanned or predetermined. Indeed, one of the characteristic features of emergence, which can be found throughout nature, is that "emergent phenomena are unpredictable before they occur, even given a fairly complete knowledge of the system components and how they interact" (Sawyer, 2015, p. 10).

Given that emergent phenomena are unpredictable, traditional conceptions of standards-based curriculum and assessment predicated on specific, often behavioural, learning goals are untenable. As Osberg and Biesta (2008) explain, "if we hold that meaning is emergent ... then the idea that educators can (or should) control the meanings that emerge in the classroom becomes problematic" (p. 315). Instead, educators need to acknowledge that emergent learning outcomes are elusive, imaginative, and contextual. For educators seeking to foster emergent learning it is more appropriate to design open-ended educative experiences with rich potential for varied meaning-making than to predefine end points and assessment outcomes for student learning. Davis and Sumara (2007) assert that teaching within this paradigm entails "expanding the space of the possible by creating the conditions for the emergence of the not-yet-imaginable" (p. 64). Openness to how educational experiences might play out is essential, as is teacher tolerance for what might at first glance appear to be untidiness or disorder. Because, when the aim is to create a space of emergence, "the unpredictability, creativity, and messiness of the lived experience of classroom practice is the result of good teaching" (Osberg & Biesta, 2008, p. 325).

How to create the conditions for emergence?

Later in this article we present and describe pedagogical principles distilled from curriculum and complexity theories that foster emergence.

These principles promote: (a) imaginative, non-mastery learning; (b) collaboration; (c) self-organisation and autonomy; and (d) recursive elaboration (i.e., revising ideas in new ways). However, we believe that the first step is to create a classroom ethos in which emergent learning is expected, recognised, and valued. And we assert that assessment practices can significantly contribute to shaping an environment that encourages and honours emergent learning.

Educational research has demonstrated that good teaching involves structuring elements (Sawyer, 2011) and that learning is enhanced by the presence of scaffolds that support and guide student learning (Mayer, 2004). However, given that emergent learning cannot be predicted, teachers must make use of structures flexible enough to bend to the shape of the emergent learning. Sawyer (2015) characterises this flexibility as improvisation:

> Conceiving of teaching as improvisation highlights the collaborative and emergent nature of effective classroom practice, helps us to understand how curriculum materials relate to classroom practice, and shows why teaching is a creative art. The best teaching is disciplined improvisation because it always occurs within broad structures and frameworks. (p. 13)

We believe teachers can engage in this kind of disciplined improvisation by designing and applying flexible assessment structures that support and provoke emergent learning.

Assessment of emergent learning

We write this article in a context where teaching and learning are driven by provincially established expectations. The assessment of these expectations is based on measurement standards, typically represented through performance levels (e.g., Level 1—50–59%; Level 2—60–69%; Level 3—70–79%; and Level 4—80+%). However, given the conception of emergent learning we described above, we are interested in asking the question: what role can assessment play in recognising and promoting emergent learning within such a context? In a standards-based, accountability framework of education, there is increased emphasis on defining specific, measurable learning expectations and establishing evaluation criteria even before learning occurs (McMillan, 2008;

Stobart, 2008). Current assessment practices typically focus on providing feedback or grading pre-established learning expectations and levels of achievement (Airasian & Russell, 2008). This approach to assessment is largely endorsed through a criterion framework that recognises the importance of establishing criteria for consistently measuring student achievement in relation to learning expectations (McMillan, 2008). McMillan (2000) notes that, within a criterion-referenced approach, fair student assessment ensures "student knowledge of learning targets and the nature of the assessments prior to instruction (e.g., knowing what will be tested, how it will be graded, scoring criteria, anchors, exemplars, and examples of performance)" (n.p.). Hence, in the current context of assessment, aligning learning and assessments to pre-established learning targets and establishing defensible criteria for judging the achievement of those targets are fundamental considerations.

While we fully support this assessment approach, we also recognise that it does not fully account for learning that occurs beyond prescribed expectations. Hence, our intention here is to demonstrate how educators can negotiate the assessment of emergent outcomes while retaining a criterion-referenced approach to the measurement of student learning. We follow other assessment scholars who have explored how teachers can notice learning in planned and unplanned ways (Cowie & Bell, 1999) and assess divergent forms of student learning (Torrance & Pryor, 1998). Early on, Sadler (1989) set the stage for thinking about the assessment of emergent learning. Sadler recognised that teachers must have room within their assessment program to make criterion-referenced judgements about student learning through qualitative feedback and comments. Sadler called for the use of "fuzzy" criteria to denote holistic judgements that are contextually based and individual to students' unique learning. Linn and Gronlund (1995) added to this argument by highlighting that assessment validity is a matter of interpretation, and that performance-based and authentic learning tasks require varied validity evidence beyond traditional psychometric properties. In the case of emergent learning, pre-established metrics may not yield valid interpretations of student learning.

In 1998, Torrance and Pryor suggested that much of assessment literature has been concerned with measuring convergent thinking (i.e., students'

grasp of preset expectations). Torrance and Pryor (2001), in their discussion of formative assessment, recognised the value of divergent assessment, which:

> emphasizes the learner's understanding rather than the agenda of the assessor. Here, the important thing is to discover *what* the learner knows, understands and can do. It is characterized by less detailed planning, where open questioning and tasks are of more relevance. (p. 617)

While Torrance and Pryor did not apply this logic directly to emergent learning as we have conceptualised it, their argument does provide a foundation for the type and context of assessment suggested in this article.

In the following section we present three approaches that directly address unpredictable learning that occurs as a result of curricular tasks: (a) ignoring emergent learning; (b) informally celebrating emergent learning; and (c) making space to formally recognise emergent learning. After describing these approaches and considering their merits and shortcomings, we turn to explore how assessment can be used to provoke emergence. In contrast to directly addressing the emergent learning, this last assessment structure focuses discretely on provoking the pedagogical and learning conditions likely to produce emergence.

To ground our discussion with a concrete example, we propose the context of a senior instrumental music course and a targeted learning expectation to: *demonstrate technical skills when performing notated music* (Ontario Ministry of Education, 2010, p. 159). Ms Sparks, the music teacher, has structured a corresponding learning task that requires each student to rehearse and perform a designated melody on his or her instrument. Ms Sparks has designed an assessment tool to identify and measure achievement of success criteria that represent a demonstrable subset (in this case, some of the "technical skills") of the broader learning expectation. Her assessment rubric addresses: (a) correct pitches; (b) accurate rhythms; and (c) appropriate articulation.

Ignoring emergent learning

The simplest assessment response to learning that falls outside prescribed learning objectives is to ignore it. For example, to expand our

hypothetical scenario introduced above, student Danica performs "Flight of the Bumblebee" on trombone. In assessing the performance Ms Sparks dutifully notes Danica's achievement of correct pitches, accuracy of rhythms and appropriateness of articulation. Ms Sparks thoroughly addresses the pre-established assessment criteria, but ignores some remarkable related learning that Danica also achieved and demonstrated:

- learning to access her older brother (studying trombone at university) as a source for advice on negotiating various tricky passages
- learning to accompany herself with a deliberate and complex off-beat foot-tapping pattern to help keep her playing rhythmically accurate.

There are advantages to ignoring such untargeted learning. When educators exclusively address pre-established and clearly delineated success criteria, assessing student performance is relatively straightforward and, with multiple students, produces more stable and consistent results. Ignoring untargeted outcomes increases reliability in assessing the identified success criteria. As an additional benefit, at the beginning of the task teachers can inform students of the learning they are expected to achieve, what they must do to demonstrate achievement of that learning, and how corresponding grades will be determined. There is no mystery involved; students can be secure in the knowledge that they are competing on a level playing field and none will receive points for playing out of bounds.

A disadvantage of ignoring emergent learning, however, is that significant and valuable learning, such as Danica's described above, is neither recognised, honoured, nor encouraged. Further, with an assessment tool that narrowly interprets learning expectations (as does Ms Sparks' assessment rubric) content validity is compromised, as the assessment tool *should* reflect the content area in its entirety (McMillan, 2003). Most significantly, by ignoring Danica's achievement with respect to seeking mentorship and kinesthetically supporting rhythmic accuracy, Ms Sparks misses powerful educative opportunities to commend Danica for identifying and taking appropriate steps to develop her musicianship—Ms Sparks' limited assessment response compromises her support of Danica's learning.

Informally celebrating emergent learning

Another possible assessment response to emergent learning moves from ignoring to honouring it with some kind of informal celebration. When a teacher notices unplanned learning she or he can identify and praise it in comments that accompany a formal assessment, or orally in a private or group post-assignment debrief. Such informal celebration need not figure prominently in formal assessment, and need not influence the learner's grade. Ms Sparks, for example, could write a report that formally measures and offers feedback regarding Danica's performance of the pitches, rhythm, and articulation, while also providing comments that recognise, celebrate, and offer direction and encouragement for her other related learning achievements.

The advantage of an informal celebration response is that the significant and relevant learning can be identified, honoured, and so encouraged. The celebration can serve to motivate a student to continue his or her efforts within the particular area of achievement. Similarly, the celebration affirms the learning choices the student has made; it affirms her or his ability to self-regulate, that is, to identify the learning that is personally significant and appropriate for the student's unique learning trajectory (Zimmerman, 2000).

However, it is very common for students to bypass comments and only pay real attention to grades. When an aspect of learning is formally recognised by assessment frameworks (i.e., it is factored into a final grade), it comes to be valued. Conversely, when an aspect of learning is not formally recognised, it is devalued (Brookhart, 2013; Madaus & Kellaghan, 1992). As a result, there exists a real risk that students who encounter learning opportunities unrepresented in pre-existing assessment frameworks may choose to pass them by, and so miss out on valuable learning. Danica may appreciate Ms Sparks' commendation regarding the toe-tapping rhythmic enhancement techniques and seeking help from her brother, but might decide her time is better spent ignoring those aspects of her musicianship in favour of focusing efforts exclusively on what the rubric specifically tells her is important.

Making space to formally recognise emergent learning

To take the recognition of emergent learning one step further, a teacher can communicate to students at the beginning of the learning experience the expectation that they *will* encounter unplanned yet significant learning. The teacher can facilitate this approach by literally leaving space to identify and measure emergent learning within the assessment tool shared (or better yet, constructed) with students before engagement in the learning task. In the case of Danica's performance preparation, for example, the listing of the pre-determined success criteria within the assessment rubric—(a) correct pitches; (b) accurate rhythms; and (c) appropriate articulation—could include space for (d) "other learning". While carrying out the required task, teacher and student could endeavour to identify learning that occurs outside the pre-established success criteria but that is nevertheless significant. This identified "other learning" could then be recorded and worked into the assessment instrument. Thus Danica's assessment rubric could be redesigned to address not only pitches, rhythm, and articulation, but also social learning and kinesthetic rhythm support.

The merit of "making space" for formally recognising emergent learning is that unanticipated yet significant learning achievement can be recognised and measured, and therefore valued. Making space also promotes awareness of emergent learning, both for teacher and students, with the benefit of building a classroom culture that expects and celebrates and therefore is primed to anticipate and benefit from unplanned learning outcomes. A further advantage is the onus on the student to identify personally significant learning. As a result, the likelihood increases for learning that matters (that is, the learning important to the learner) to be recognised, honoured, and celebrated by student and teacher. The student's reflective process in identifying emergent learning may also enable the identification of learning not encountered, that is, next steps. This active involvement of the student in analysing her or his own learning has valuable self-regulation and assessment as learning (AaL) implications, in that the student is encouraged to take on and develop the role of expert in his or her own learning process.

However, there are disadvantages in the making-space approach. For example, the reliability of the assessment process is problematic. How can

the teacher consistently identify emergent learning from one student to the next? When emergent learning is identified, how will its achievement be accurately and consistently accounted for? What if the teacher or students, or both, tend to notice or value certain types of emergent learning and not others? How will students feel about the vagueness and lack of definition regarding this ephemeral aspect of their work and the undefined grading of it? While involving students in identifying and measuring emergent learning will allay some of these concerns, the approach is messy and complex.

Nevertheless, despite the inherent lack of reliability in seeking and measuring varied emergent learning for different students, *if* the primary purpose of the assessment is to represent students' learning both planned and unplanned as connected to the curricular task, arguably, the validity of the assessment is enhanced. Moss (1994) proposes a hermeneutic orientation to classroom validity involving:

> a holistic and integrative approach to interpretation of human phenomena that seeks to understand the whole in light of its parts, repeatedly testing interpretations against the available evidence until each of the parts can be accounted for in a coherent interpretation of the whole. (p. 7)

Though not uncontested, Moss claims this approach can generate important and influential evidence for valid interpretations of student learning in response to complex classroom tasks. While we recognise that such an orientation may limit reliability, the use of a hermeneutic orientation to assessment and validity enables consideration of the divergent learning that can emerge from complex curricular tasks.

Given the interpretive nature of the making-space approach to assessing emergent learning, its effectiveness and feasibility will vary from context to context, requiring flexibility and responsiveness to students' individual learning, open negotiation between teacher and students, and a careful balancing of reliability and validity principles of classroom assessment.

Provoking emergent learning

In the section above we explored ways that educators might negotiate the assessment of emergent learning reactively, after it happens. Each

successive strategy provided increased treatment and valuing of emergent learning. While the final strategy—making space to formally recognise emergent learning—more fully accounts for emergent learning than the previous approaches, we believe educators can go further to actively support and even provoke emergence. Our intention in this section is to explore ways that assessment can encourage emergent learning at the onset. To do this, we first explain pedagogical principles that have been demonstrated to provoke emergent learning, and then apply those principles to the design of assessment tools.

In this section, then, we invite teachers to shift from the assessment of emergent learning itself to the assessment of students' use of pedagogical principles, distilled from complexity theory, that yield emergent learning: (a) imaginative, non-mastery learning; (b) learning with and from others; (c) self-organising and autonomous learning; and (d) revising ideas in new ways (i.e., recursive elaboration).

Pedagogical principles for emergent learning

While emergent learning is unpredictable, complexity scholars have explored the pedagogical orientations and contextual conditions through which it can occur. These orientations and conditions provide a basis for enabling emergence, and as we argue, planning for the assessment of emergent learning. Specifically, we identify and promote the following four pedagogical principles that enable emergent learning: imaginative, non-mastery learning orientation; learning occurs with and from others; students as self-organising and autonomous; and recursive elaboration. Each is now discussed in turn.

1. *Imaginative, non-mastery learning orientation*. Scholars recognise that emergence occurs when student and teachers work within imaginative spaces that balance the development of technical knowledge with imaginative possibilities (Osberg & Biesta, 2008; Davis & Sumara, 2007). Davis and Sumara (2007) contend that

> teaching, like learning, is not about convergence onto a pre-established truth, but about divergence—about broadening what can be known and done. In other words, the emphasis is not on what *is*, but on what can be brought forth. (p. 64)

They further articulate that emergence requires expanding the space of possibility rather than "perpetuating entrenched habits of interpretation (or even exploring the limits of current imagination)" (p. 64). Pedagogically, then, a teacher is to work against a strict mastery orientation where students learn to prescribed desired ends and instead, works to unsettle rote learning and provoke exploration of ideas into newly imagined domains. For example, rather than memorising a multiplication table students could be encouraged to explore and present relationships among sets of numbers through different modalities. Students might choreograph a dance that features shifting groupings of dancers, or create poems that feature mathematical relationships amongst the number of syllables in each line and stanza.

2. *Learning occurs with and from others*. Stacey (2003) acknowledges that emergent learning always occurs in relation to others, often directly provoked through social engagements: "Key insight from the complexity sciences is that interactions between entities have the intrinsic capacity to produce emergent coherence in the absence of any blueprint or program" (Stacey, 2003, p. 14). Accordingly, this principle works within a socio-constructivist orientation towards teaching and learning in which students interact with one another to construct their own, often innovative, ideas and representation of knowledge. Pedagogically, teachers leveraging this principle create opportunities for students to work together through cooperative learning tasks. As an example, consider a curricular task to design an advertisement for a magazine. In response to this task, the teacher forms groups and assigns roles: one group member is to focus on linguistic communication, another on images, and another on design principles. The student teams each work towards a magazine advertisement with these consistent elements, each student learning from the others' knowledge strengths as they construct a joint product.

3. *Students as self-organizing and autonomous*. Building on the previous principle, allowing students to self-organise into groups of learners and giving them the autonomy to select their own approach to learning can provoke emergence (Stacey, 2003). Self-organisation "refers to processes by which autonomous unities can come together into larger, more powerful unities ... The resulting higher-order unities have capacities that

can vastly surpass the potentials of their participants" (Davis & Sumara, 2007, pp. 57–58). When students work to configure their individual learning in relation to others, and in relation to the whole group, the overall net learning is enhanced (Davis, Sumara, & Luce-Kapler, 2007). Building on the example presented above of the task to design a magazine advertisement, allowing students to self-select their groups and plan their own approach to the task would enable multiple organisational group formats within the classroom all based on the same curricular assignment. Teachers can help students build on their strengths to organise in ways that make optimal use of their expertise and learning approach, thereby enhancing the resulting products *and* the learning encountered as the group members worked together at optimum capacity.

4. *Recursive elaboration*. Finally, the concept of recursive elaboration serves to enable emergence. Recursive elaboration involves revising ideas in new contexts and new formats, balancing individual and collective sense-making. Inviting students to re-interpret their learning and providing space for new representations of knowledge engages a recursive learning process (Davis, Sumara, & Luce-Kapler, 2007). As an example, students may learn about a theme from a literary work and then consider how that theme relates to their own life. Students might then explore how the theme operates in the lives of others they know, and in society.

These various principles have been recognised in curriculum and complexity literature to provoke emergent learning. In our effort to use assessments as incitement for emergence, in the following section of this article, we apply these principles to the design of assessment structures.

Assessment as provocation of emergent learning

By making these principles explicit for students, and using assessment to provide feedback on the extent to which the principles are operationalised during learning experiences, teachers can enhance classroom conditions for emergent learning. In this section, we develop a sample rubric to demonstrate this concept. We emphasise that the rubric we present is only one possible representation of these principles at work, and encourage teachers to draw from this sample to design their own assessment

structures that are appropriate for encouraging emergence within their own unique teaching contexts.

Our constructed rubric explicitly identifies the pedagogical principles of emergence and then provides descriptive criteria across levels of use. Descriptive criteria articulate distinguishable qualities evident across *levels of use* in language that is useful to students and teachers. We apply this structure to construct a rubric for monitoring students' use of the principles likely to provoke emergent learning (see Table 1).

Table 1. Rubric on students' use of pedagogical principles for emergent learning

Pedagogical principle for emergent learning	*Levels of use*		
	Level 1	**Level 2**	**Level 3**
Imaginative learning	Student relies on previous work samples and exemplars to construct product	Student references exemplars but extends into original product	Student learning is shaped by others' ideas and previous knowledge leading to novel representations and innovative conceptualisations
Learning with and from others	Student works mainly on his/her own	Student works in collaboration with another student/group of students	
Self-organisation and autonomy	Student relies on teachers' instructions to guide steps in his/her learning	Student organises his/her own learning to benefit from others	Student identifies his/her learning needs and strengths and works with others to meet his/her needs and share his/her strengths
Recursive elaboration	Student learns discrete concepts but does not apply them in new contexts or link them together	Student is able to apply prior learning in new contexts and link discrete learning together	Student actively seeks new and different contexts in which to extend and apply learning to create innovative products and conceptualisations

Structurally, our rubric presents levelled criteria for four principles of emergent learning. The rubric criteria describe qualitative levels that

demarcate students' use with the four principles, moving from low use (Level 1) to high use (Level 3). Students operating at Level 1 are likely to construct knowledge and products that are closely aligned with the pre-determined learning expectations and that resemble previous student work. At this level, there is little room for emergence. In Level 2, the criteria present qualitative behaviours related to each discrete pedagogical principle. In contrast, Level 3 criteria combine principles of emergent learning. Students at Level 3 tend to operate in a creative collective that not only enhances the quality of learning about the desired outcomes but also encourages emergent learning to occur.

Using the provocation of emergent learning rubric

To demonstrate how we envision educators and students making use of the provocation of emergent learning rubric, we return to Danica and her curricular task of preparing a piece of music for performance.

In relation to the pedagogic principle of *imaginative learning*, Danica achieves Level 1 by learning to play "Flight of the Bumblebee" the same way she has learned to play other pieces before: she studies the musical score, looks up slide positions (for the pitches she does not already know how to produce) in her trombone method book, and listens to recordings of others playing the piece. Danica achieves Level 2 by adding something original to her performance: the complex off-beat foot-tapping accompaniment that she develops to help maintain rhythmic accuracy. Danica achieves Level 3 by collaborating with a street performer she has seen, who tap dances on a loudly resonant hardwood board as he plays the fiddle. Danica consults the street performer, and with his help she locates a suitable hardwood board to position beneath her own feet as she performs. To extend the potential of the percussive hardwood board, Danica attaches a tambourine, an old-fashioned "kahooga" car horn she can work with her foot, and a self-inflating whoopee cushion. After much exploration and practice, the percussive foot-track Danica develops not only helps her maintain rhythmic accuracy but also provides a complementary (and humorous) multi-timbral percussive counterpoint to her trombone melody.

The descriptor for achievement of Level 3 represents a combination of the pedagogic principles of imaginative and collaborative learning, which

Danica demonstrates by adapting the street performer's idea to enhance the novelty and innovation of her own performance.

For the pedagogic principle of *learning with and from others*, Danica achieves Level 1 by working on her own with the score, method book, and recordings. She achieves Level 2 when she works with her brother to figure out how to negotiate some of the tricky sections of the piece. She achieves Level 3 by incorporating what she has learned from her brother to other sections of the piece: in the faster sections she slides between pitches rather than articulating each note, which results in an original and innovative interpretation of the score.

To demonstrate the pedagogic principle of *self-organisation and autonomy*, Danica achieves Level 1 by working on her own with the score, method book, and recordings. She achieves Level 2 when she realises she needs some help, and seeks advice from her brother. She achieves Level 3 by identifying not only her need for help with trombone slide position technique, but also her strength in creating foot-tapping accompaniments to help with rhythmic accuracy. She shares this strength with two classmates, and helps them develop foot-tapping patterns to accompany their own pieces.

For the pedagogic principle of *recursive elaboration*, Danica achieves Level 1 when she learns to match various notes on the musical staff with particular trombone slide positions and air pressures to produce the represented pitches. As another aspect of her Level 1 achievement, she learns to tap her foot to keep the notated rhythms steady and accurate. Danica achieves Level 2 by applying that knowledge to a new context (a hitherto unseen musical score), linking her knowledge of the various rhythms and pitches together to learn and play "Flight of the Bumblebee". She achieves Level 3 when she learns to play a variety of pieces (new and different contexts to apply her learning), all with unique foot-tapping accompaniments, thereby creating a series of innovative products and conceptualisations.

The provocation of emergent learning rubric presented above is intended to help teachers and students monitor their use of the pedagogical principles likely to provoke emergent learning. Emergent learning can occur at each level of the rubric; however, students who use the pedagogical

principles more often (i.e., students operating most consistently at Level 3) may experience greater emergence and innovative learning than those operating at a Level 1. By monitoring their use of these principles, teachers and students can adjust the learning environment to further encourage emergence. Used this way, this type of rubric serves to build students' capacity for self-regulation, engaging them in purposeful assessment as learning (AaL) practices. Teachers can take this idea further. They can invite students to co-design these rubrics or reflect on the ways that they have adjusted their behaviours or the environment to better engage these practices. These reflective assessment activities support students as learners within and beyond disciplinary expectations. That said, the use of this rubric does not account for emergent learning; it solely encourages it. To celebrate and assess emergent learning, we assert that teachers and students must find ways to make space for, identify, and honour emergent learning, both informally and formally, as we describe earlier in the article. Coupling the assessment of emergent learning with the assessment of students' use of pedagogical principles for emergent learning will enable teachers to both encourage emergence and recognise when it occurs while explicitly acknowledging the conditions that provoke it.

Discussion

A journey is seldom only about the destination. While a predetermined endpoint is certainly helpful in setting forth, and steering the course, the detours and encounters along the way often prove to be the most memorable aspects of the trip. There is an inherent paradox within the current expectation-driven, standards-based curricular framework shaping educational systems throughout the world. The advantage of this curricular framework is that there is a good chance students will learn what is expected of them. The disadvantage is that the students will learn *only* what is expected of them—that is, their learning will be limited to prescribed expectations and will not push beyond towards unplanned learning.

Our intention with this article is to encourage educators to recognise and consider the potential and power of un-targeted learning. We also want to continue the conversation about the ways in which assessment structures can account for emergent learning in classrooms (Linn & Gronlund,

1995; Torrance & Pryor, 1998, 2001; Sadler 1989) to stretch measurement and classroom assessment theory beyond its current expectation-based approach. To this end, we have presented initial possibilities for considering emergent learning whilst retaining a criterion-orientation to assessment.

Our approach to stretching assessment towards the emergent involved first exploring reactive strategies (i.e., informally celebrating and making space for emergent learning) and then proposing a proactive strategy—a rubric predicated on the pedagogical principles likely to stimulate unplanned yet meaningful classroom learning. Bridging curriculum theory, and in particular complexity thinking, with classroom assessment practice appears a fruitful direction for continuing to explore the phenomenon of measuring emergent learning. What we seek to do next is solicit the perspectives and experiences of students and teachers as they wrestle to engage in and assess emergent learning. This empirical data will enable us to refine and extend the ideas presented in this article. Hence future research should engage educators in thinking through and articulating practices that use assessment criteria to not only recognise but also encourage emergence within their classrooms. Specific challenges ahead in this research agenda are to: (a) consider the reporting and weighting of emergent learning in relation to pre-established curricular expectations; (b) determine equitable methods for valuing emergent learning within a class of diverse learners; (c) examine how principles of reliability and validity can operate within an emergent framework of learning; and (d) consider the role and importance of emergent learning within standards-based educational systems.

As the anecdote of the guitar sisters illustrated at the beginning of this article, the best of teaching intentions can be gloriously overshadowed by the richness, diversity, and complexity of learning. In this article we addressed the space between what teachers plan and what students might achieve. Our primary purpose was to encourage the recognition of unintended learning. Our secondary purpose was to propose how to influence the pedagogical context to offer strategies for enhancing the likelihood that unplanned learning will occur. We hope to have provided here some ideas that will help educators measure and incite the magic of emergent learning.

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