

OBSERVING AESTHETIC EXPERIENCES AND POĒSIS IN YOUNG STUDENTS

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Anathi and Thembela are Grade 3 girls, both 9 years old. They have spent about eight minutes working on the puzzle activity shown in Figure 1. The aim is to find the values that relate to each shape to ensure that the row and column totals shown would work. The girls have figured out the value of five for the circle and eight for the triangle. Both girls are now working on the second row of the grid; they know that they have a value of 13 (from the circle and the triangle) and need to find the value of the two clubs to get 25 as a total. These excerpts come from a longer task-based interview in one of my after-school clubs.

Anathi [breathes in sharply] Ooooh. Eish [1], hey, hey. You see what I did? [she looks at me whilst she talks] I went like [pause] I went [pause] 13 [tapping the circle and triangle on the 2nd row of the puzzle] and then I went [pause] [she starts counting on her fingers] 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25. [she turns towards me and makes a questioning hand gesture] Aaah! [in an excited tone]

Me What's the difference? What is the difference there? [Anathi looks at me, throws back her arms and leans back in her chair]

Anathi did not respond to my question in words, but she continued to look directly at me whilst she straightened her arms down next to her body and leant back in her chair. She turned back to look at the puzzle and covered her mouth with her hand. I asked the question again. She sat forward in her chair and wiped her face with her hands. She seemed unsure what to do next. Perhaps she did not know what I meant by the word 'difference'. Rather than breaking her

▲	♣	▲	●	
♣	●	♣	▲	25
●	●	●	●	20
▲	♣	♣	▲	
				26

Figure 1. Mathematical activity.

train of thought, I encouraged her to count again, "Do it again for me. You did 13 [expectant pause]" The 'comic strip' in Figure 2 depicts what happened next [2].

Although there does not seem to be a clarity in Anathi's verbal answers, there is a wealth of information in her non-verbal or multimodal interactions that suggest some element of surprise and intense engagement in the task. The example above led me to think of the times I have seen students come alive whilst working together; when they experienced 'aha moments'. Of course, many famous people are documented as having aha moments in mathematics, but

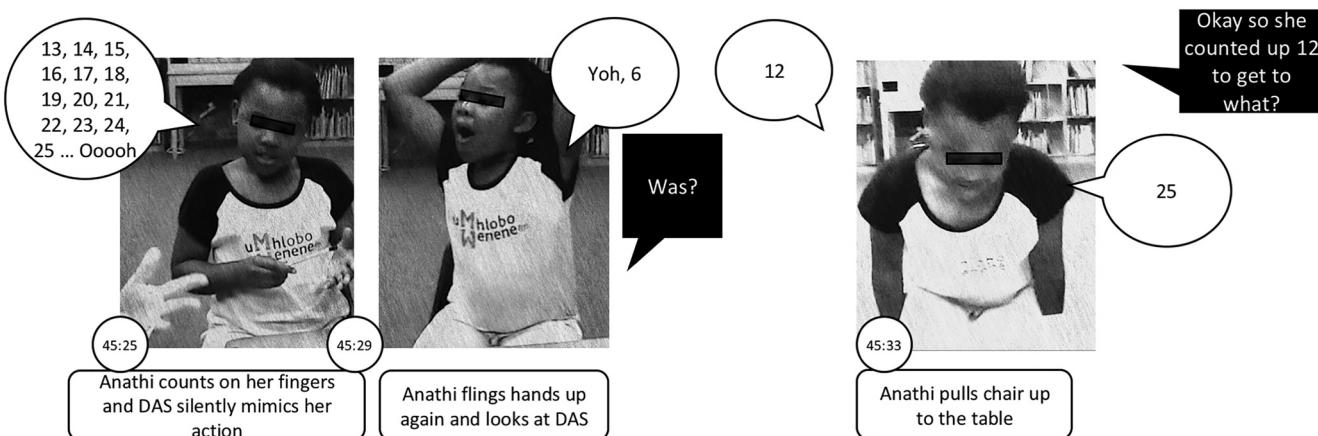


Figure 2: Anathi, on the brink of an aha moment?

Liljedahl emphasises that they are also an “elusive, yet real part of ‘doing’ mathematics” (2005, p. 220) in everyday contexts. Although still elusive and vague, was Anathi on the brink of having an aha moment?

I recalled a conversation I had with Luis Radford at the 13th ICME conference in Hamburg. We were chatting about the theory of objectification and he suggested that he had experienced two uses for the theory: one as a technical tool to make sense of data and the other where the theory plays a seamless poetic role in telling a research story. He emphasised the humanness of coming to know mathematics and that there are poetic moments in research where we can see *the mathematics come to life*. Outside of a research setting these moments are often captured in a photograph, but following this conversation with Radford, I wondered if such aha moments could be described poetically and how they could be analysed and represented methodologically. I set out to try it.

Some background about Radford’s ideas

The ideas I share here are not intended to add new knowledge to the field, but rather to provide an initial review of Radford’s comments about the poetic role of theory and his related work on moments of poēsis in terms of its appeal and usefulness in research contexts. While Radford’s ideas are not his alone, they are the starting point for this article. The sampling of literature is driven by the multimodal interactions we see in the excerpts and related comic strips. The literature in turn helps to explore aspects that arise from Radford’s definitions to understand and clarify them in the context of mathematics education.

Radford refers to the idea of mathematics coming to life using the term “living phenomenon” (2015a, p. 563). Through this living phenomenon, coming to know can be grasped through the “overt manifestations” (Radford & Roth, 2011, p. 243) of a range of multimodal forms of communication or sensuous actions. Multimodal forms can include speech, gestures, gaze, hesitations, intonations and postures; sensuous actions are those that relate to being perceived by or affecting the senses of sight, touch, smell and so on. Often sensuous relates to something that is aesthetically pleasing to the senses.

From an analytical perspective, Radford states that the process of learning (objectification) entails “moments of poēsis”, which bring “forth something to the realm of attention and understanding” (p. 551). Poēsis, he claims, “is a creative moment of disclosure—the event of thing in consciousness” (2010, p. 3). He argues that in the encounter with the mathematical structure, the moment of poēsis gives rise to an aesthetic experience. These moments result from the complex connections between the semiotic means of objectification that accompany and orient the students’ “perceptual, aural, linguistic and imaginative activity” (p. 6).

Although he originally referred to these moments of poēsis in connection with Vygotsky’s zone of proximal development, his more recent work frames these ideas in the theory of objectification within spaces of joint action and togethering (Radford, 2015b), which is the theoretical space he and I were discussing. For brevity, I will not define these terms here as I will not be using the constructs directly; see Radford and Roth’s (2011) paper for definitions.

Before moving forward, I note that Radford’s concept of moments of poēsis encompasses several other essential aspects: sensuous actions (or multimodal forms), creativity and aesthetic experiences, all of which need to be unpacked and understood to make sense of his construct. I will attempt to do this by referring to the excerpts of data from this same interview.

Are poēsis and poetic two seemingly similar constructs?

It is clear that Radford refers to both poetic and poēsis. I turned to standard dictionary definitions to find clarification. Poēsis, which originates from the Ancient Greek ποίησις (*poēsis*), meaning production or composition, can be thought of as a process of making, producing or creating. Wikipedia also defines it as “the activity in which a person brings something into being that did not exist before”. Poetic, however, is an adjective normally used to describe the characteristics of something with the beauty and imaginative qualities found in good poetry and is not frequently used in describing mathematics [3]. At this point it seems that poēsis and poetic are distinctive: one suggests personal activity and creation, whilst the other is purely descriptive and relates to aesthetics and emotion. I can move forward with the sense that one is active whilst the other is descriptive.

What is the connection between an aesthetic experience and poēsis?

To investigate Radford’s assertion that the moment of poēsis gives rise to an aesthetic experience, I will return to the interactions presented in the two excerpts above. We observe a complex arrangement of gestures, exclamations, language, gaze and body movements / postures between myself and Anathi. In this complex arrangement, there are several instances that could pinpoint this as a possible aesthetic experience for Anathi.

Firstly, we can see Anathi’s initial discomfort and struggle particularly when she covers her mouth and wipes her hands across her face. Secondly, Anathi’s exclamations that include “Ooooh. Eish, hey, hey”, “Yoh”, and “Oooh” are possible indicators of surprise. Thirdly, these exclamations are coordinated with her physical body movements such as throwing her arms down beside her body, and over her head, leaning back in the chair and then finally pulling her chair back into the table, all of which may serve as further indicators of her feelings.

Aesthetics, deriving from the Greek word αἰσθητικός (*aisthetikos*), means “capable of sensory perception”. Seemingly, there may already be a tenuous link with the concept of sensuous actions used by Radford and aesthetics. Anathi’s sensuous actions and exclamations echo the physical reactions of surprise that Sinclair (2001) observed in her work. Sinclair’s observations of students engaged in mathematics tasks revealed how they reacted physically to a task, showing some form of surprise: by widening their eyes, sitting upright or moving forward, making a sound such as ‘ooh’, or saying some form of ‘wow’. She notes that surprise in this form is only of value to mathematical learning if it *engages* the student in sense-making in that “it prompts the student to try and understand something about what they are seeing” (p. 29).

In later work, Sinclair (2008) extends this argument stating that the “interaction of the emotion with understanding and mathematical meaning gives rise to the aesthetic artifact” (p. 34), and she stresses that the emotional responses must correlate with mathematical engagement, *i.e.* the emotions are not separate from the mathematics.

If, as Sinclair suggests, that emotional engagement in a mathematical experience is key to an aesthetic experience and that the emotional responses must correlate with that engagement, Anathi’s exclamations of surprise and her physical actions may well signify emotional engagement and a determination to engage in sense making. For me, pulling her chair into the table whilst looking directly at the puzzle indicated that she meant to focus and make sense of what was going on. All the afore-mentioned sensuous actions also indicate an early awareness that something mathematical is happening for Anathi, although she is not able to put her finger on what it is yet.

Let us explore Anathi’s experience a little more. The comic strip shown in Figure 3 continues on directly from Figure 2.

Although Anathi had given the answer of 6 previously (45:29 in Figure 2), she wasn’t aware of this, as she said 12 shortly after in response to my question. I propose that when Anathi used the phrase “Oooh” (as an indicator of surprise) in the final frame of Figure 3, her physical sensuous actions (dancing in her chair and tapping the chart) coordinated with her speech and something came into Anathi’s realm of attention. I’ll talk about *what* a little later. Further, her posture also suggests confidence or satisfaction.

It is possible that she noticed that in counting up from 13 to 25, she got 12, but that the 12 needed to be divided into two equal parts to account for the two clubs in the second row of the puzzle *i.e.* she had to halve the 12. Her whole body, including her emotions, were seemingly invested in this emerging personal insight. I argue that this sense making (finally making sense of the value for the club) was an aesthetic one, as evidenced by her body movements, gestures, eye contacts, exclamations and other sensuous actions. Dietiker (2015) emphasises that an aesthetic moment can be the motivation to advance through challenges and setbacks. If Anathi is emotionally engaged, based on Sinclair’s

argument, I suggest that this is an aesthetic experience for Anathi. Thus, we could surmise that the aesthetic experience made up of all her sensuous actions and other multimodal forms does seem to provide Anathi with the motivation to make sense of what is happening here and to finally find, and understand, the value for the club in the puzzle.

‘Wow’ aesthetic experiences

Uhrmacher (2009) claims that aesthetic learning experiences exist on a continuum. As such, not every child’s aesthetic learning experience could be described as a ‘wow’ experience. It is still however an aesthetic experience. On reflection, I suggest that Anathi’s experience was not ‘wow’ for the following reasons.

Radford (2010) points out that moments of poēsis are made possible by both the teacher’s and the students’ shifts of attention, and that becoming aware of these moments may “empower” teachers to give students time to “enjoy these precious moments” (p. 6). Radford’s thoughts are echoed by others: Liljedhal (2005) observes that as teachers we should take advantage of these moments but ponders how to do so; Uhrmacher (2009) highlights that an aesthetic learning experience provides possibilities for a student to feel satisfaction, which results from being connected to what they are learning and engaged with it on a sensory level. Conceivably, Anathi’s moment of poēsis could be attributed both to the activity in which she was engaged and to the complex sequence of interactions between the two of us, and may not have occurred without this sequence of interaction.

As facilitator, I am not certain that I took advantage of Anathi’s moment sufficiently. I could see Anathi’s aesthetic experience and the fulfilment of it but I do not believe that I helped her to become aware of it or allowed her time to enjoy or celebrate it sufficiently. If I had given Anathi time to do so, perhaps she may have felt some pleasure or satisfaction and been more aware of her achievement. With further discussion, we may also have explored in more detail how she had solved this problem, whether there were other ways to solve it and focus more on the mathematics. I too have learnt from this process. It is not just about orchestrating or observing the experience in others, but rather finding ways to help them see the wonder in mathematics and allowing them the

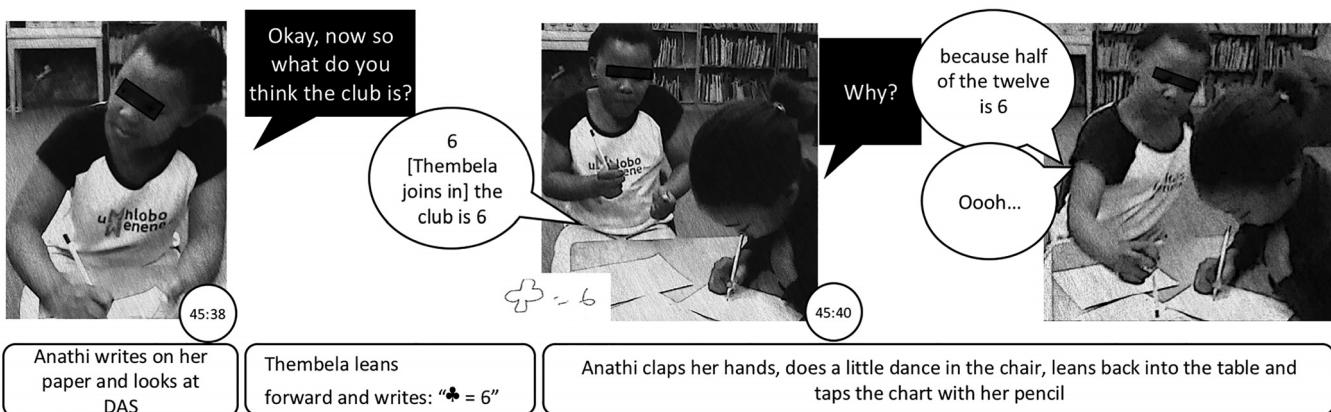


Figure 3. Anathi’s continuing experience.

time to reflect on it themselves, to understand what they have just experienced. I will take this learning with me in my continued work with in-service teachers and students in the mathematics clubs.

And what of the creative aspect?

Recall that Radford's definition of moments of poēsis includes the notion of creativity: "a creative moment of disclosure". Kaufman and Beghetto (2009) suggest that Anathi's personal insights could be considered creative, even if she was unable to express them tangibly. Their *mini-c* notion of creativity highlights that mental constructions can be considered as creative even if they have "not (yet) been expressed in a tangible way by a student" (p. 4). From an aha perspective, Liljedahl (2005) supports this, highlighting that the primary result of an aha experience is successfully solving a problem or coming to understand a piece of mathematics, although this might not be a giant leap of understanding, merely an expected mathematical progression. These considerations are important for young students in South Africa, such as Anathi, who learn in English, which is not their home language, and who may not yet be able to express themselves fully in a tangible way.

Could this type of personal creativity relate to Radford's creative moments of disclosure in moments of poēsis? Is he perhaps considering a *process* of personal creativity where students, in the moment, create mathematically meaningful new ideas, methods, interpretations, and so on for themselves in the process of learning (objectification)?

In bringing all this together, we can finally ask if Anathi experiences a moment of poēsis. I have tried to argue that she is experiencing mathematics in an aesthetic manner. Further, I suggest that this moment could be Anathi's *own personal creative moment of discovery*, integrally intertwined in her learning process where she reveals insights that are unique and personal to her at this moment, in this context. She was drawing on knowledge that she already had and was possibly interpreting it in a different way and making sense of it in this context. The final sequence in Figure 3 captures how Anathi 'lives' through a process of creating mathematical meaning for herself. It exemplifies Radford's description of a creative moment and something coming forth to the realm of attention and understanding during a moment of poēsis.

The only aspect that is unclear from the sequences of interactions I've presented is what is coming to her attention. Is she simply aware of finding the answer; or of understanding the need to halve or is she aware of some possible mathematical structure? I cannot say anything conclusive about this from this data but it certainly deserves further exploration from a research perspective.

Are these types of moments important in a learning experience?

My last thought is why are moments of poēsis / aesthetic experiences important in mathematical learning processes, if at all? The mathematics education literature I reviewed makes it very clear that we need to make mathematics less boring, more engaging, personal and relevant, and to find ways to make it come alive for students. Sinclair (2009)

speaks to the motivational aspect of aesthetic experiences for students that derives from the feelings of satisfaction. Liljedahl (2005) echoes this sentiment when talking of aha moments: they "inspire us and encourage us to keep going" and "besides being a great accomplishment is also a measure of what is possible" (p. 231). Uhrmacher (2015) feels strongly that "the upshot of providing aesthetic learning experiences is likely to include student satisfaction, an increase in perceptual knowledge, episodic memory retention, meaning making, and creativity and innovation" (p. 613).

These are important considerations. Lockhart [4] summarises the kind of engagement that he believes is required for learning mathematics, which includes confusion, frustration and being alive:

To do mathematics is to engage in an act of discovery and conjecture, intuition and inspiration; to be in a state of confusion—not because it makes no sense to you, but because you gave it sense and you still don't understand what your creation is up to; to have a breakthrough idea; to be frustrated as an artist; to be awed and overwhelmed by an almost painful beauty; to be alive, damn it (p. 8).

Representing the living phenomenon in print

I cannot finish this article without mentioning some issues I considered in portraying these moments. In my work, I have found the traditional written transcript format for representing video data limiting in portraying the dynamic and complex nature of interaction between people. When I began to analyse the data for this and other papers, I was faced with the dilemma of simply using that traditional format or finding another more authentic way to show the participants' sensuous engagement in the task. I began to understand that if, in fact, I wanted the theory and method to merge seamlessly, the traditional transcript would not work as I could not *see* or *show* the all-important sensuous actions I needed to tell a more complete story.

So, while the traditional transcript avoids all ethical problems, it is not authentic. Encountering a similar dilemma, Plowman and Stephen (2008) adopted a comic strip format to represent the *richness* of their video data. Although the method of doing this is time-consuming and complex, I have adapted this format for this and other papers to represent the dynamic processes that took place between participants in a way that I consider connects both method and theory, making it a useful format within this theoretical space and for extending the story in a more poetic/aesthetic way.

There is also a dilemma between providing authentic data and maintaining an ethical commitment to the people involved in the research who have been offered anonymity. Even though the photographs used here have been altered using an 'arty' filter, they still do not offer complete anonymity. Yet, the photographs are an important part of understanding the full multimodal interaction—the facial expressions particularly so. Therefore, it is necessary to return to the research participants to gain permission to use the photographs to portray the story in a different way. In my case, I originally had no intent to use this video data to portray such authentic interaction, and I did not have consent to use the photographs as I do here. I was fortunate in that I

could contact the parent of the child involved in this interview to request permission to include these photographs in this article.

Concluding remarks

Are Radford's notions useful from an analytical and methodological point of view? I mentioned earlier that the mathematics education community is calling for more attention to be given to the aesthetic elements of learning mathematics. Sinclair's 2009 article strongly advocates for an awareness of aesthetic issues in teaching and learning stating they could be a "liberating" and connective force for mathematics education. From this perspective, I would suggest that Radford's ideas are timely and much needed and deserve further exploration in research contexts which have less focus on the cognitive aspects of learning.

Dietiker (2015) raises the point that an absence of terminology to describe mathematical aesthetical experiences may be a contributing factor in the current lack of attention on the aesthetic dimensions in mathematics curricula. I suspect that Radford is trying to find ways to describe these types of experiences in relating mathematics learning to moments of poēsis, including notions of creativity, aesthetics and imagination. I would argue that such terminology is also important for analysing and describing research that is focused on more aesthetic aspects of learning.

I note, however, that for my analysis to move forward for this article, I felt the need to clarify and understand Radford's descriptions by examining the characteristics of creativity and aesthetics from related literature. This provided me with a useful set of 'analytic indicators' or terminology that I could look for in the video data and use in the accompanying narrative. Without these alternate interpretations, I confess that I may have struggled to provide the insights that I have. It was also essential to grapple with different ways to present the video material on the printed page, to exemplify the multimodal and sensuous actions of the participants. Therefore, I believe that there is scope for further work to be undertaken in refining analytical indicators for the notion of moments of poēsis [5] and in developing more authentic ways of presenting the data. Further research may also investigate whether moments of poēsis do allow for student satisfaction, motivation, personal creativity and mathematical meaning making as suggested here.

I started this article wondering whether theory and analysis can play a poetic role in telling research stories and if it was possible to observe moments of poēsis and aesthetic experiences in mathematics education research. I suggest that from these short excerpts a research story can unfold

and be portrayed in a poetic, aesthetic way and that the theory and method work well together, allowing us to see mathematics as a 'living phenomenon' for this one child. Whether this account is poetic or not is left up to the readers to judge, based on their own aesthetic experiences of mathematics.

Notes

- [1] *Eish* is used in South African English and Afrikaans to express exasperation or disbelief.
- [2] Thembela was sitting back in her chair and listening but not interacting with us during this part of the episode. *Yoh* is a South African phrase that can be loosely translated as 'Wow', indicating surprise or awe.
- [3] Although, there are some (see Pimm & Sinclair, 2009 for example) who refer to the two together.
- [4] In *A mathematician's lament*, published online in the Devlin's Angle column of the MAA website. https://www.maa.org/external_archive/devlin/LockhartsLament.pdf
- [5] I have begun some of this work in a recent publication. See Stott, forthcoming.

References

- Dietiker, L. (2015) What mathematics education can learn from art: the assumptions, values, and vision of mathematics education. *Journal of Education* **195**(1), 1–10.
- Kaufman, J.C. & Beghetto, R.A. (2009) Beyond big and little: the four C model of creativity. *Review of General Psychology* **13**(1), 1–12.
- Liljedahl, P.G. (2005) Mathematical discovery and affect: the effect of AHA! experiences on undergraduate mathematics students. *International Journal of Mathematical Education in Science and Technology* **36**(2–3), 219–234.
- Pimm, D. & Sinclair, N. (2009) Audience, style and criticism. *For the Learning of Mathematics* **29**(2), 23–27.
- Plowman, L. & Stephen, C. (2008) The big picture? Video and the representation of interaction. *British Educational Research Journal* **34**(4), 541–565.
- Radford, L. (2010) The eye as a theoretician: seeing structures in generalizing activities. *For the Learning of Mathematics* **30**(2), 2–7.
- Radford, L. (2015a). Methodological aspects of the Theory of Objectification. *Perspectivas da Educação Matemática* **8**(18), 547–567.
- Radford, L. (2015b) The epistemological foundations of the Theory of Objectification. *Insomnia—Epistemologia* **8**, 127–149.
- Radford, L. & Roth, W.M. (2011) Intercorporeality and ethical commitment: An activity perspective on classroom interaction. *Educational Studies in Mathematics* **77**(2–3), 227–245.
- Sinclair, N. (2001) The aesthetic "is" relevant. *For the Learning of Mathematics* **21**(1), 25–32.
- Sinclair, N. (2008) Attending to the aesthetic in the mathematics classroom. *For the Learning of Mathematics* **28**(1), 29–35.
- Sinclair, N. (2009) Aesthetics as a liberating force in mathematics education? *ZDM* **41**(1–2), 45–60.
- Stott, D. (forthcoming) Attention catching: Connecting the space of joint action & togetherness. In Presmeg, N., Radford, L., Roth, W.M., Kadunz, G. & Puig, L.(Eds.) *Signs of Signification in Mathematics Education Research: Semiotics in Mathematics Education*, Springer.
- Uhrmacher, P.B. (2009) Toward a theory of aesthetic learning experiences. *Curriculum Inquiry*, **39**(5), 613–636.

Being *for* the learning of mathematics implies being *on the side of* the learners of mathematics (and the people who teach them). FLM welcomes articles and communications that keep this goal in plain view.

— David Wheeler, 2(2), p. 9
