



Construing and building resilience: a case study of the use of Grid Algebra

Construit, 15th July, 2017

Sue Johnston-Wilder

“Construit: primary focus is on using computer-related technology to stage interactive experience of unprecedented richness and subtlety.”

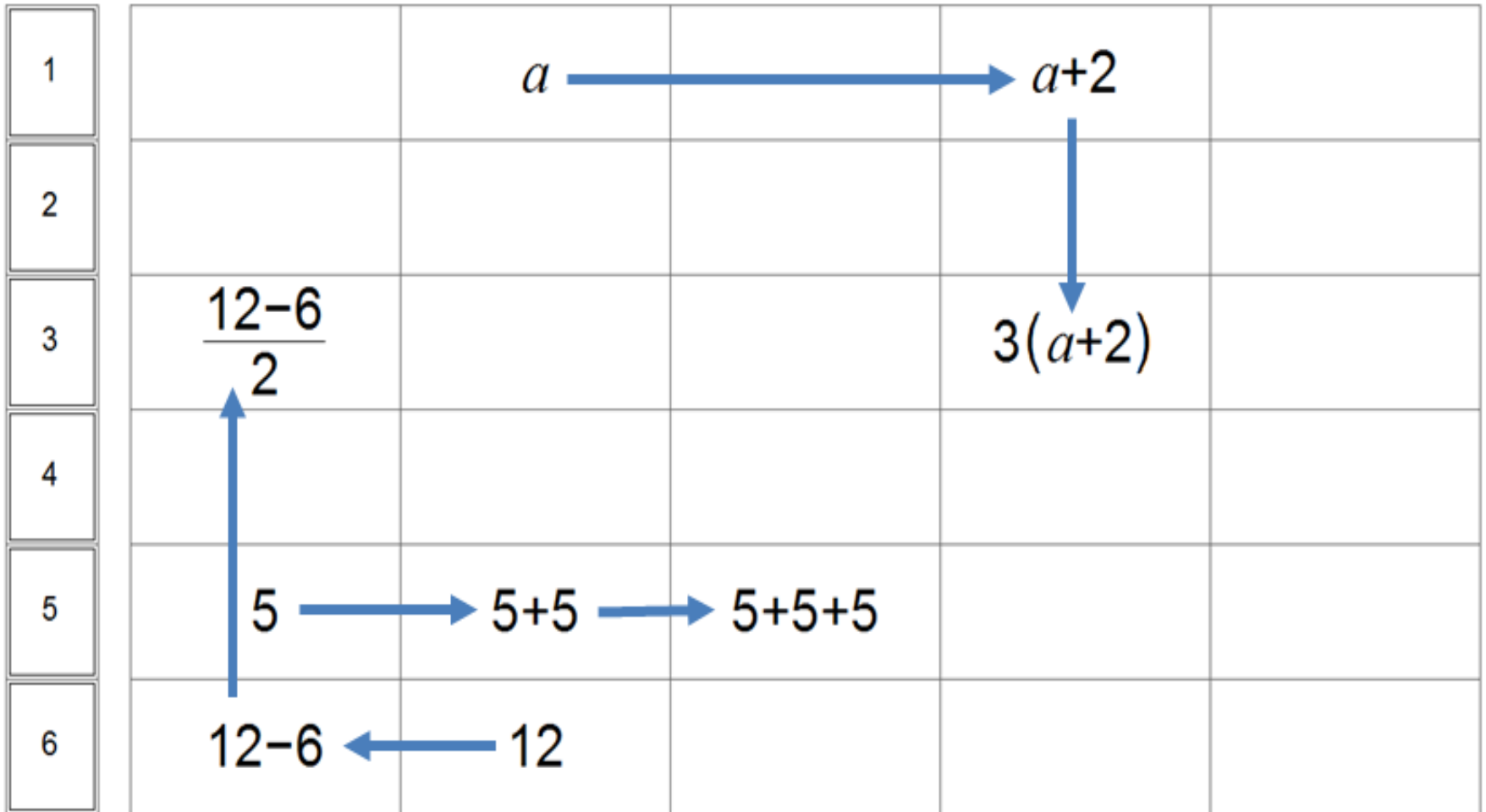
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25
6	6	12	18	24	30



observables (the grid squares and elements)

dependency (changes to these entities are deemed to be concomitant)

agency (the learner)



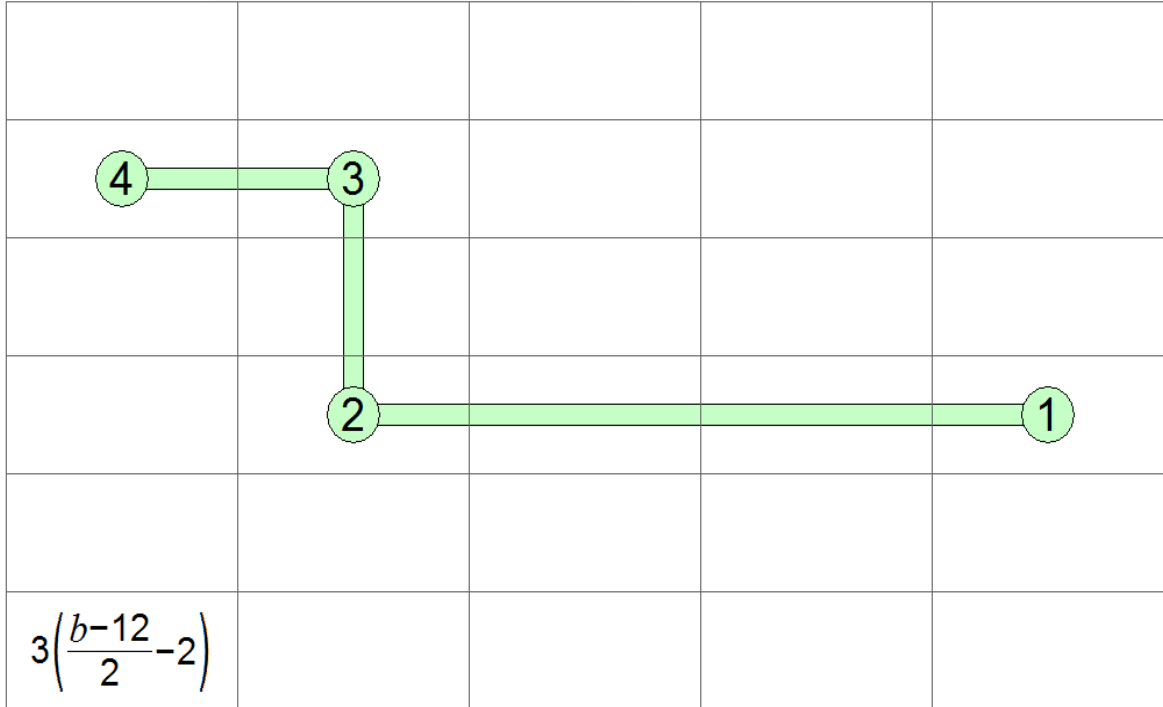
“... a construal as an 'object-to-converse-with' - generalising Papert's 'object-to-think-with' (as in his book *Mindstorms*)”

1	$a-1$	a		$a+2$	
2		$2a$	$2a+2$		$\frac{30}{3}$
3	$\frac{12-6}{2}$			$3(a+2)$	
4					
5	5	5+5	5+5+5		
6	12-6	12			30



- 1
- 2
- 3
- 4
- 5
- 6

$$3\left(\frac{b-12}{2}-2\right)$$



Find the journey
(letters)

I've Finished
Start Again

Score : 4 out of possible 4
Puzzle : 5 of 10
Level : 3 of 10

1					
2		$2\left(\frac{40-5}{5}\right)$			
3					
4					
5			40		
6					

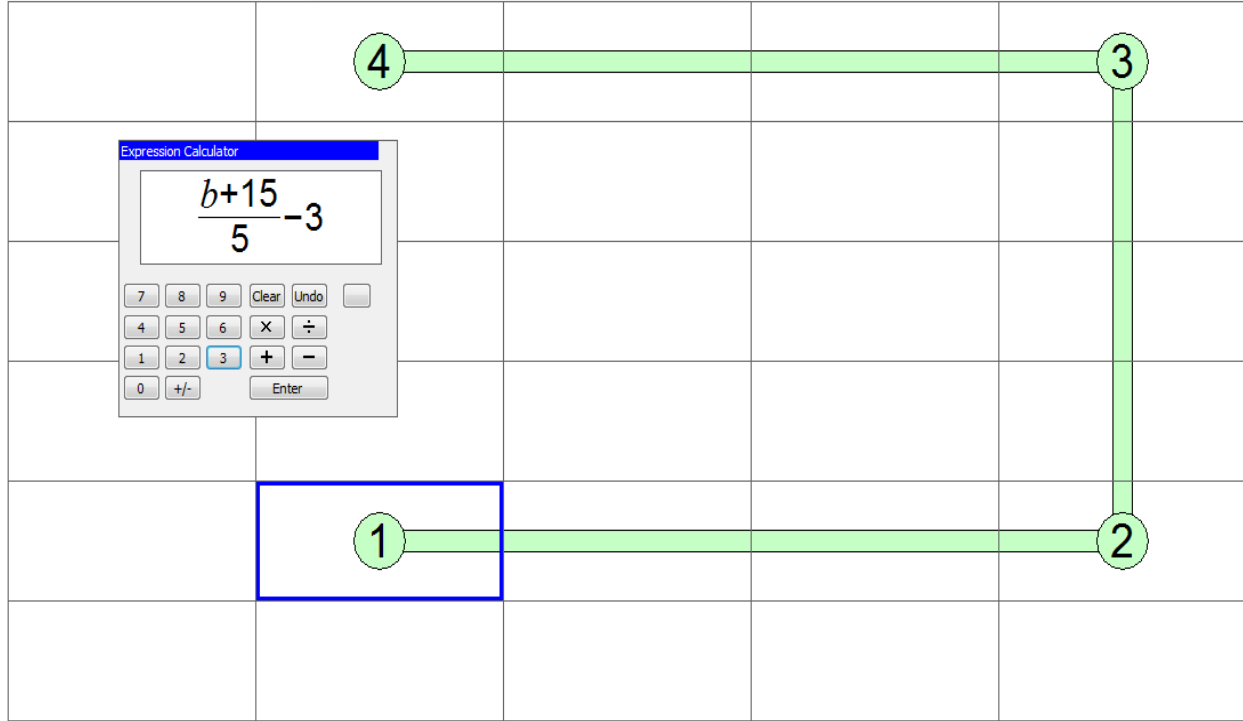
calculating

7 8 9 10 11 12 13

Score : 3 out of possible 4
Puzzle : 5 of 20
Level : 3 of 10



- 1
- 2
- 3
- 4
- 5
- 6




What is the expression?

Score : 3 out of possible 5
Puzzle : 6 of 10
Level : 3 of 10

“By its nature, construals are fluid and informal constructions ... we may change our minds.”


1				
2		a		
3				
4				
5				
6			$3(a-2+6)-6$	

Sorry

 That does not get you to the final cell - so 0 points!

OK

Expression Calculator

 $3a-6$

7 8 9 Clear Undo

4 5 6 \times \div

1 2 3 + -

0 +/- Enter

Simplify

Score : 4 out of possible 4
Puzzle : 3 of 10
Level : 3 of 10



Maths: TIRED or ALIVE?

T.I.R.E.D.

Tedious

Isolated

Rote

Elitist

De-personalised

(adapted from Nardi & Steward, 2003)

A.L.I.V.E.

Accessible

Linked

Inclusive

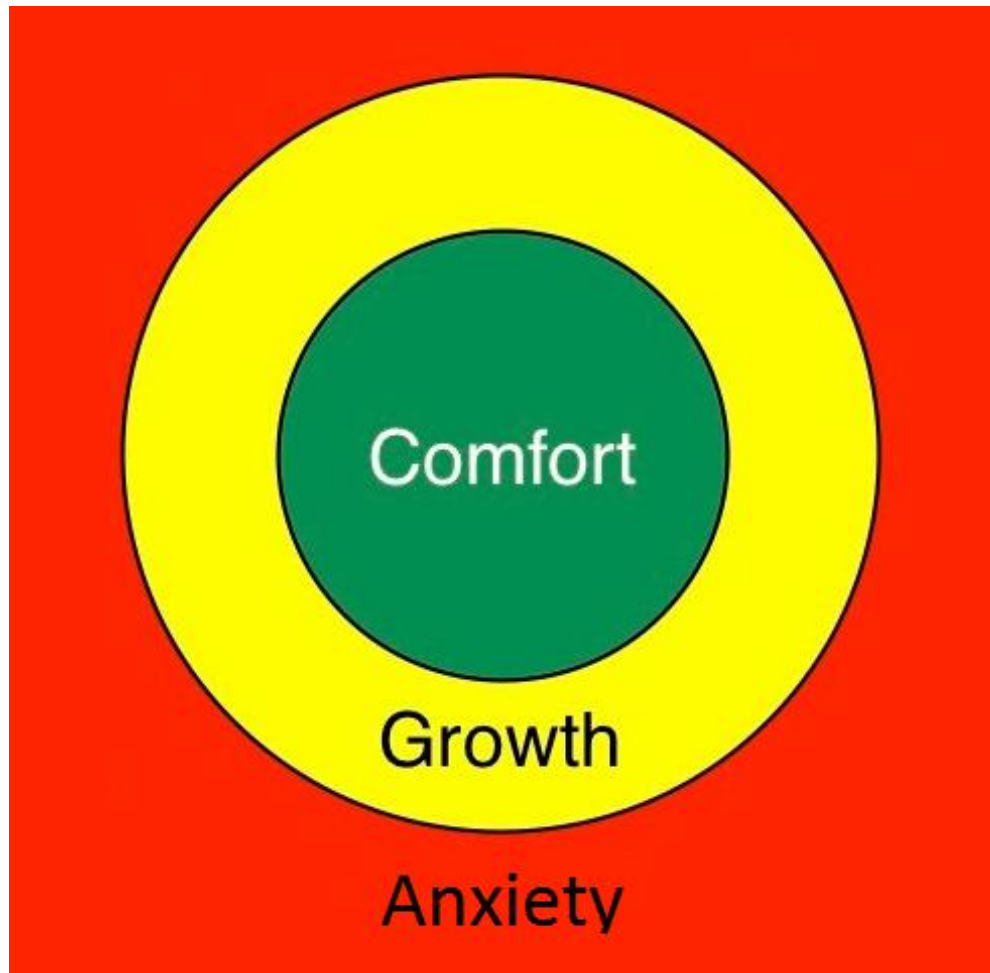
Values-based

Engaging

(Johnston-Wilder et al, 2015)



Growth zone model



(Lee & Johnston-Wilder, 2013)



Key points

- ▶ Cruising in the **comfort zone** can build self-confidence & provide opportunities for practice & automaticity.
- ▶ New learning happens in the **growth zone** – it should be safe to make mistakes, get stuck, require support & find activity challenging & tiring.
- ▶ The **danger zone** is where what is being asked is not within the learner's reach *at the moment*, even with support. Stress increases and little or no useful learning takes place.

Data from a secondary school in Kenya – from a year 7 cohort



Grid Algebra makes learning algebra fun, interesting and easy. You get to understand better as you do it practically and you also enjoy. It helped me realise that expressions are not as hard as everyone thinks. The books make mathematics look hard a lot! I got to understand deeply the basics of expressions, how they come to be, in a more real manner.



This makes mathematics very enjoyable, involves critical thinking, and is a more relaxed way of learning.



R236: *You get to have fun in learning mathematics outside the normal class lessons. Normal class lessons tend to be boring and the computers help to explore more on maths.*

U065: *It makes algebra seem simpler and fun than when it was taught in the classroom. It made algebra more fun and exciting.*

G022: *I got to do algebra practically thus increasing my rate of understanding the topic and dozing became less often as it was more fun.*



K117: Before Grid Algebra was introduced, I hated the topic in mathematics because I understood nothing! But when it was introduced, I like the topic because I enjoy doing it and also I can understand what I am taught.



P171: *It has given me another way of learning. It has made me form a mental picture when calculating algebraic expressions, e.g. when I remember how the arrows move in the computer.*

U108: *When taking my exams, I recall the Grid Algebra lessons that were so scintillating and interesting. The layout is so real and unforgettable thus sticks in my mind, so I imagine a grid in my exam. It helps a lot.*

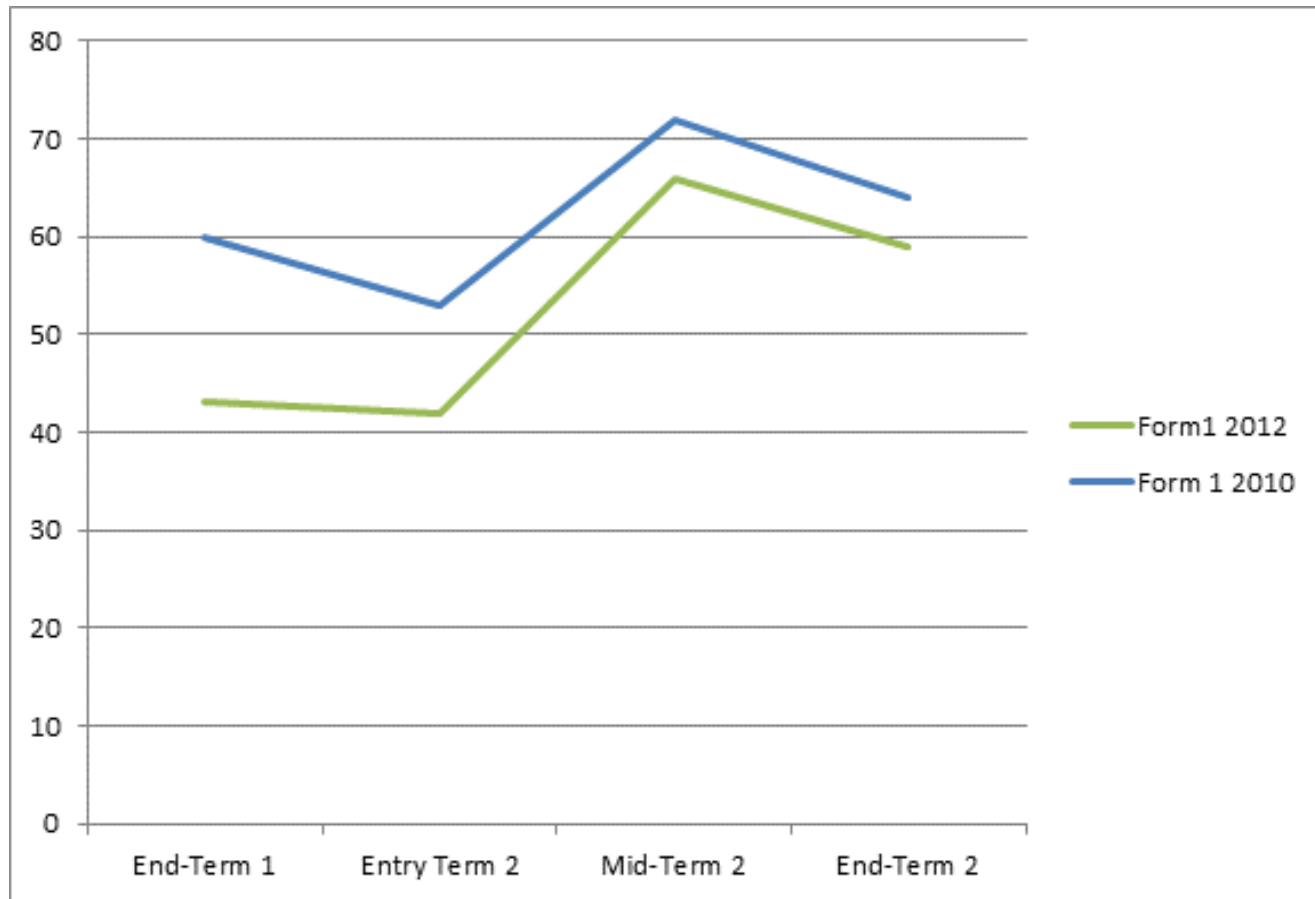
T4: I have never seen these pupils so absorbed in the work they are doing like they were today!

... I have especially liked the way the software encouraged, motivated them to try more work.



P187: *With Grid Algebra, I understand algebra a bit more than before. It is also fun to work with a computer while doing maths. Most of the time I do not 'anticipate' to learn maths. With Grid Algebra, I usually 'anticipate'; it made me understand maths especially algebra.*





- transformation of pupils learning algebra
- emphasis on collaboration, articulation, agency and variety mediating the use of an ICT tool
- engagement, enjoyment, new confidence, and eagerness to participate in mathematics
- six major themes emerged:
 - changed learning environment,
 - learner agency,
 - changed motivation,
 - accessible learning,
 - affect and enjoyment,
 - variable teacher 'learning' behaviour.



“We suggest that skills in using, modifying and creating interactive computer-based artefacts - construed in our sense - could be transformative for education if their potential could be realised.”

- ▶ Detailed description of features at www.atm.org.uk/shop/products/sof071.html

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