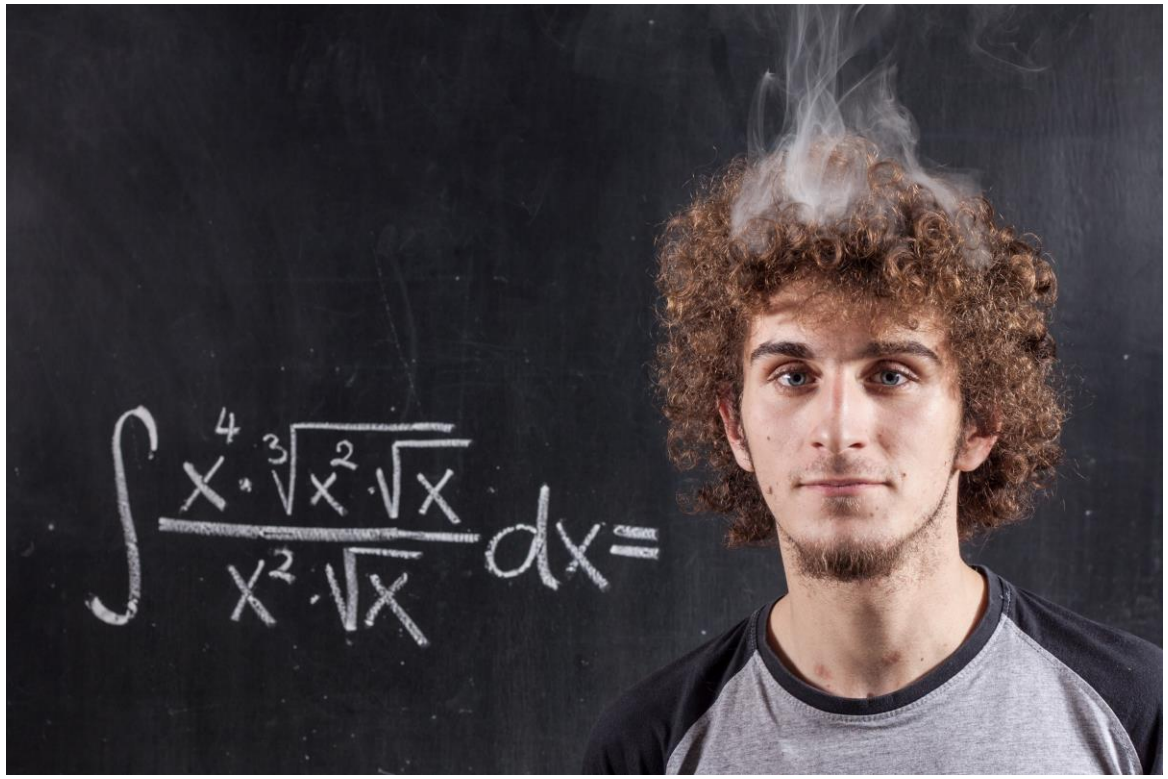


Association of Civil Engineering Departments

Dr Brian Williamson
Department of Mathematics
School of Engineering
University of Bolton

Building up a Head of *S.T.E.A.M.* in the Maths Foundation Year!

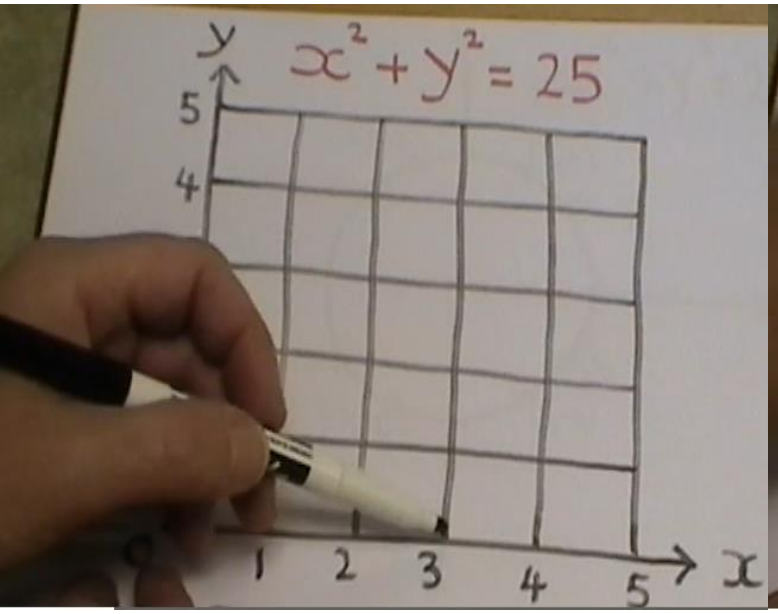
University of Bolton

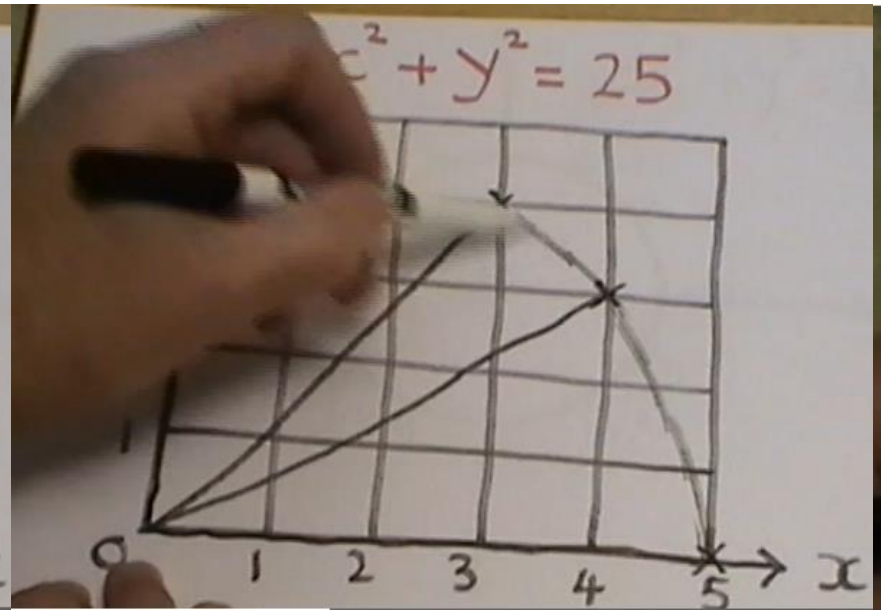
Teaching Intensive, Research Informed

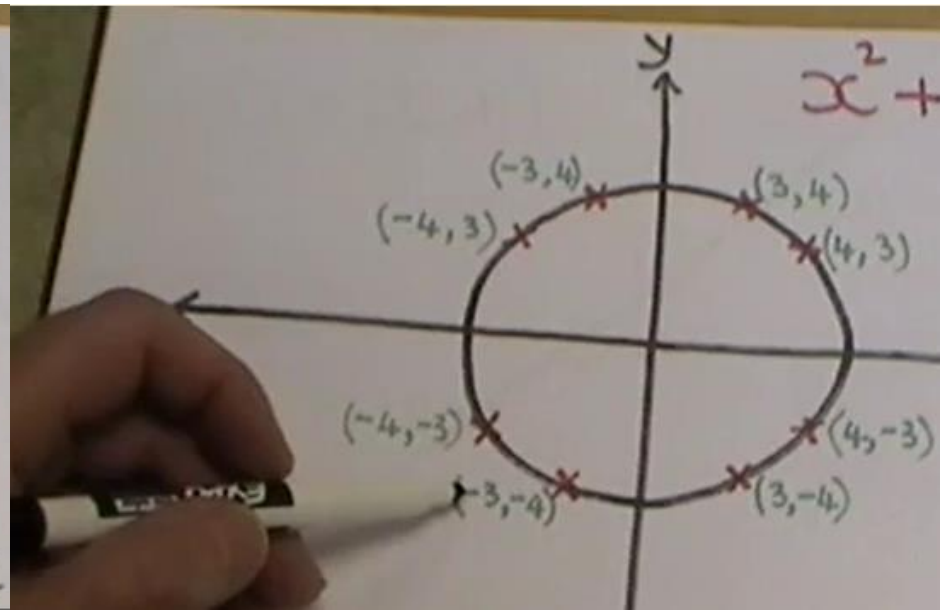
2016 -17

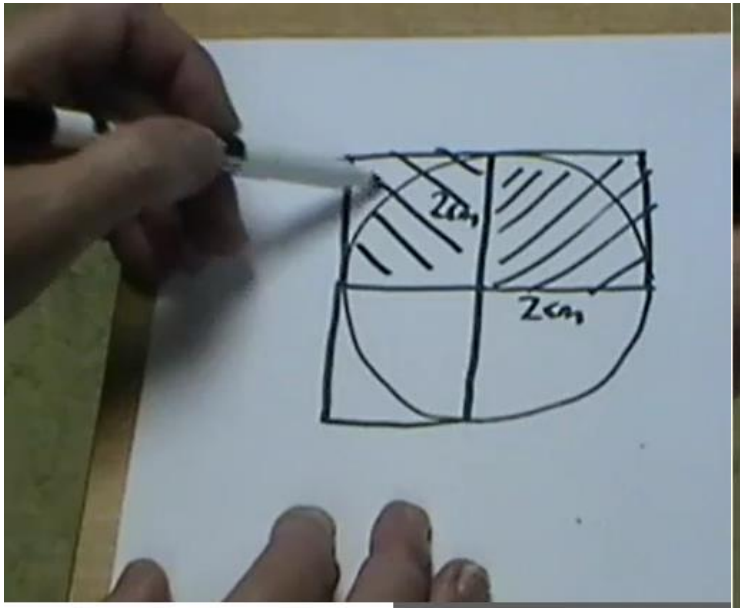
S.T.E.A.M.

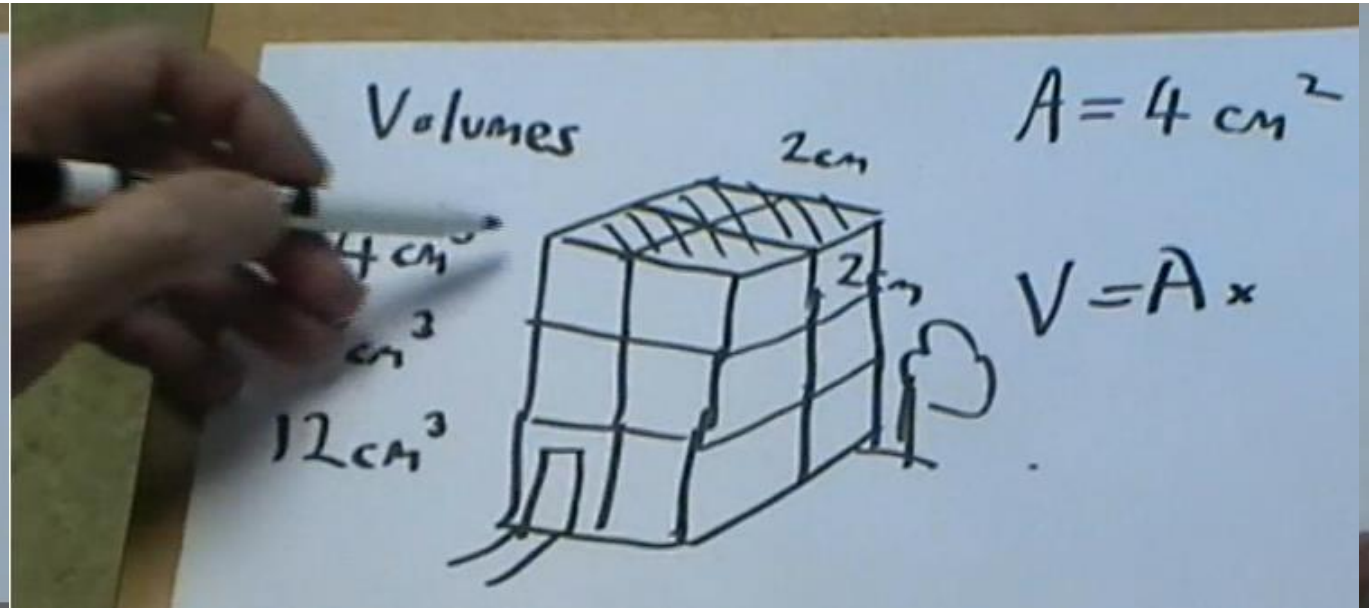
from me!

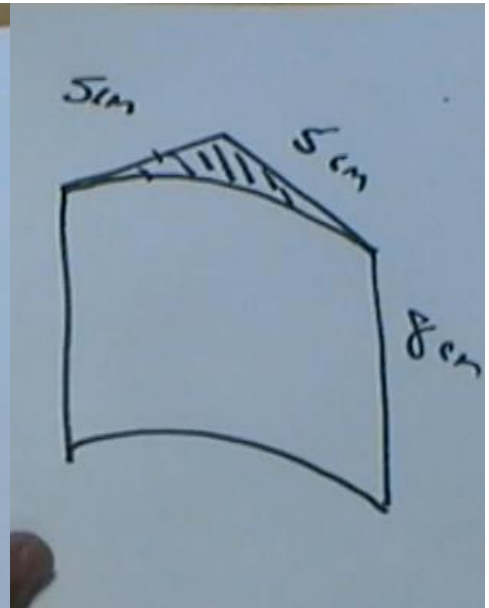

$x^2+y^2=25$
y
5
4
1 2 3 4 5
x


$x^2+y^2=25$
0
1 2 3 4 5
x


y
(-3,4)
(3,4)
(-4,3)
(4,3)
(-4,-3)
(4,-3)
(-3,-4)
(3,-4)


2cm
2cm


Volumes
$A = 4\ cm^2$
2cm
2cm
$V = A \times$
$12cm^3$


5cm
5cm
8cm

Williamson, B. (2018). Three stages of student engagement in a flipped classroom environment. Journal of Learning and Student Experience 1: 2.

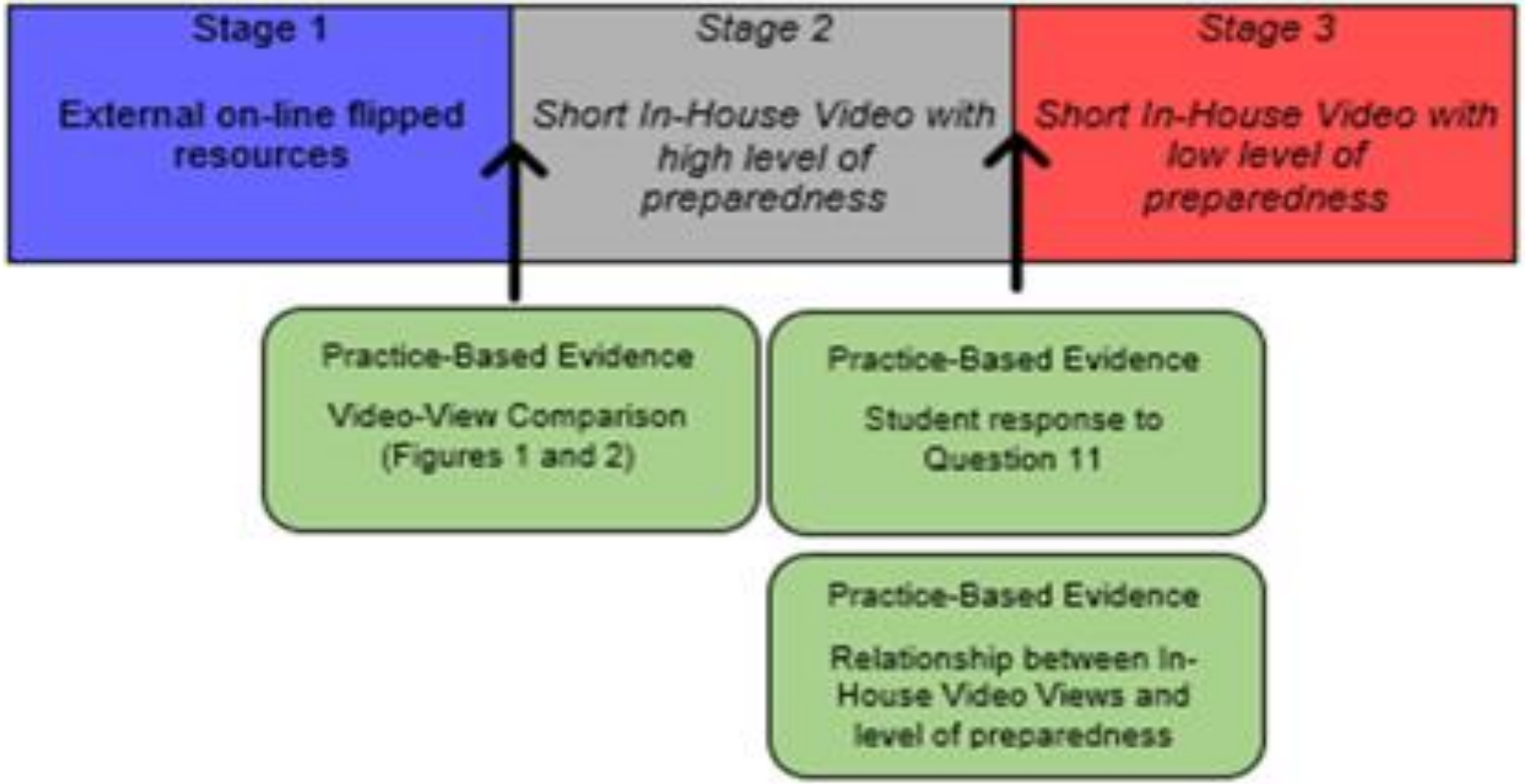
Abstract

The literature suggests that students tend to prefer in-person lectures to video lectures. This paper identifies potential causes of this phenomenon and triggers of student engagement in a flipped-classroom environment.

Eight short in-house mathematics videos were prepared and made available to foundation engineering students on the university's virtual learning environment, prior to each topic being discussed in class. The in-house videos were viewed more than accompanying external on-line video lectures for all topics covered. Students preferred in-house videos with a voice describing a drawing as it is being drawn, not one drawn earlier, and an equation as it is being written, not one written earlier. In-house videos that were produced using high numbers of pre-prepared pages tended to be viewed less.

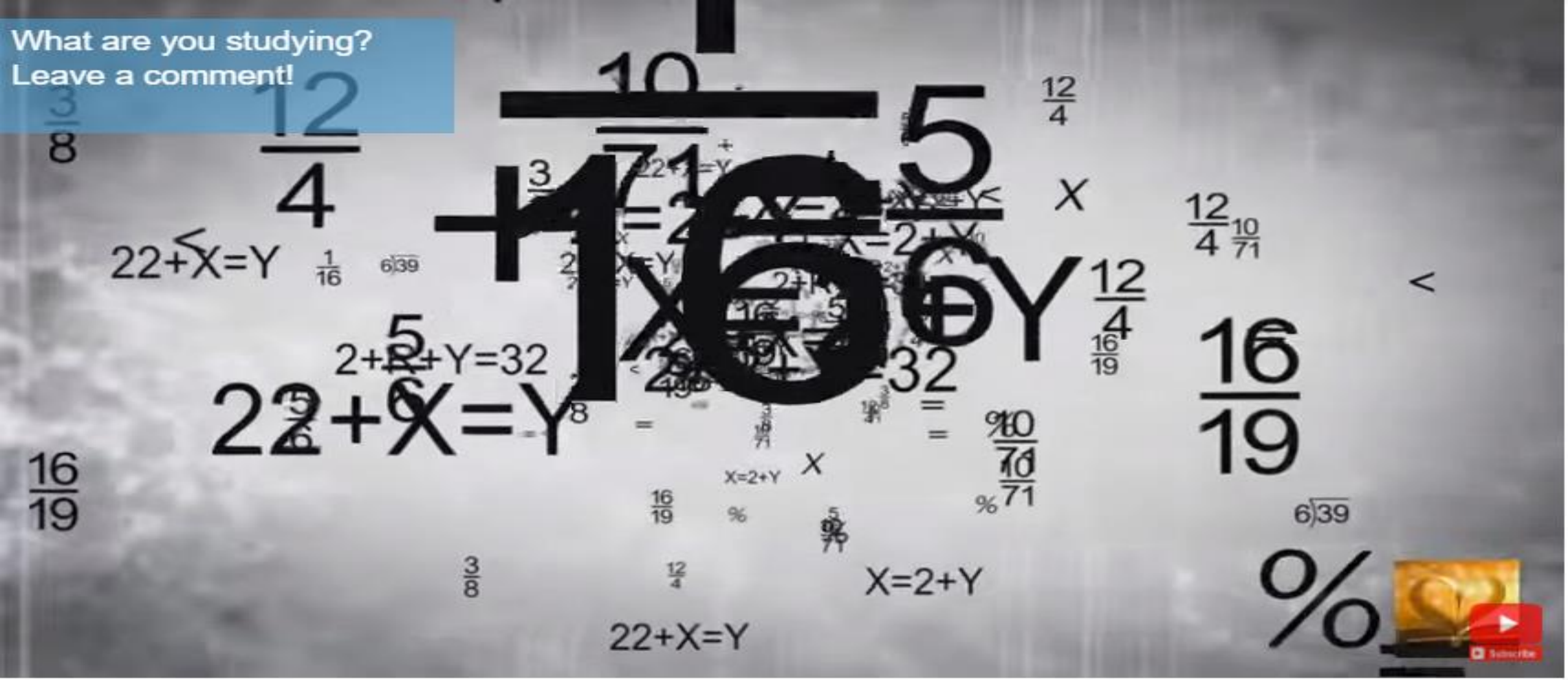
These findings suggest a gradient of student engagement from the external on-line video lecture to the interactive group learning experience. Three evidence-based stages of student engagement are proposed: (1) external video, (2) in-house video with high numbers of pre-prepared pages and (3) in-house video with low numbers of pre-prepared pages. Further validation of these stages of student engagement, and an exploration of lecturer preparedness and social presence during the production of short in-house mathematics videos, is recommended.

Three Stages of Student Engagement



2017-18

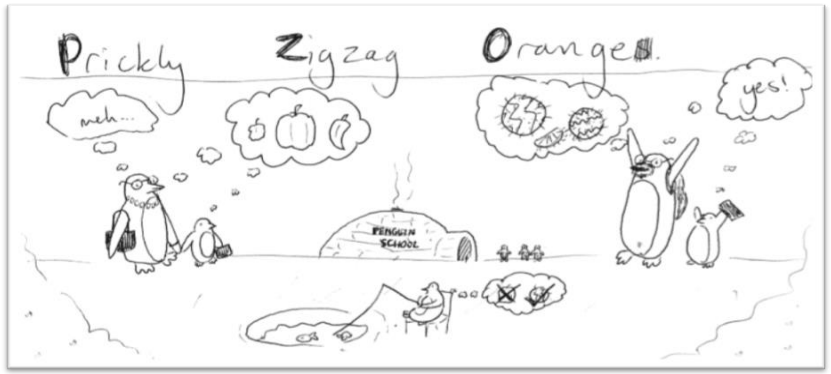
Embedding S.T.E.A.M



STUDY MUSIC: Math and Physics Exams, Concentration Music, Brain Power Music, Focus on Learning

https://www.youtube.com/watch?v=mkTYE_24TOE

Comic Strip Table



Opportunity to create your own comic strip inspired by one idea or example from the lecture notes and to feedback on those created by peers.

PEER FEEDBACK FORM

Opportunity to create your own comic strip inspired by the lectures and to feedback on those created by peers.

Name of creator		
Criteria	Your comment	Score 1, 2, 3, 4 or 5
Fun!		
Clear maths message		
Visual appeal		
Makes you laugh		
Total Score out of 20		

Problem Making – Problem Breaking Table

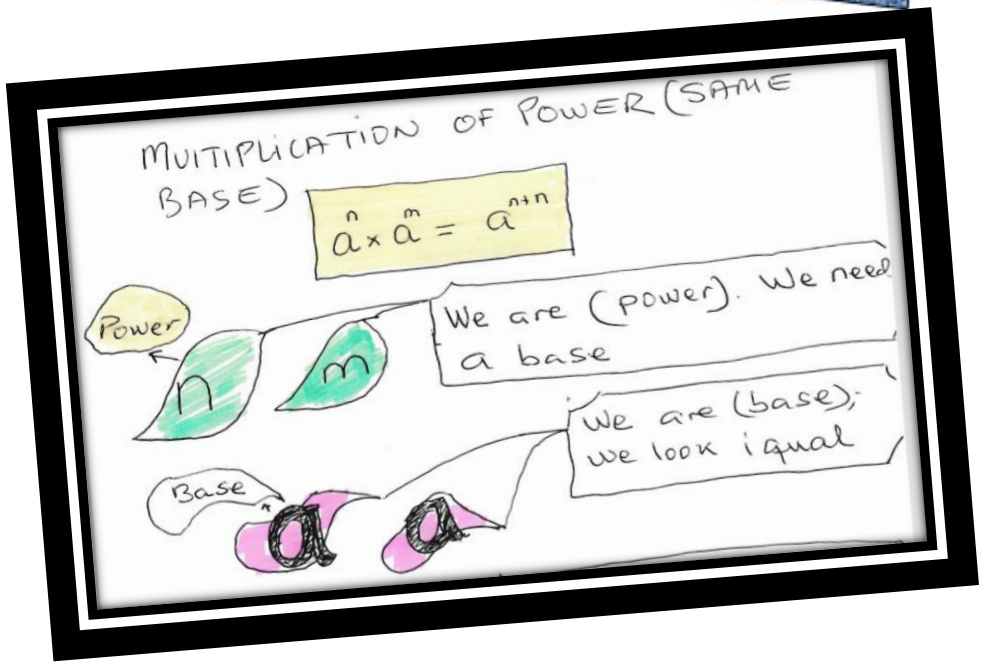
Opportunity to set a realistic problem based on the work we have covered and to receive feedback on your problem making skills from your peers.

Problem Making - Problem Breaking Table

Who is the problem maker?					
The problem they made					
Who is the problem breaker?					
The answer they gave					
Problem maker's feedback					
Problem breaker's feedback	Trivial	Really easy	I had to think a bit	I did it eventually!	Impossible
Points	0	1	2	3	0
For this task the problem maker scores …					

Graphics

Table



Opportunity to design a memorable poster/design/art work that will help you to understand or remember a concept or method we have covered.

PEER FEEDBACK FORM

Opportunity to create your own comic strip inspired by the lectures and to feedback on those created by peers.

Name of creator		
Criteria	Your comment	Score 1, 2, 3, 4 or 5
Fun!		
Clear maths message		
Visual appeal		
Makes you laugh		
Total Score out of 20		

Flipped Classroom Video Table

Creative Engagement Student Video Reflection.mp4

Opportunity to produce a memorable flipped classroom video that will help you to understand or remember a concept or method we have covered.

PEER FEEDBACK FORM

Opportunity to create your own comic strip inspired by the lectures and to feedback on those created by peers.

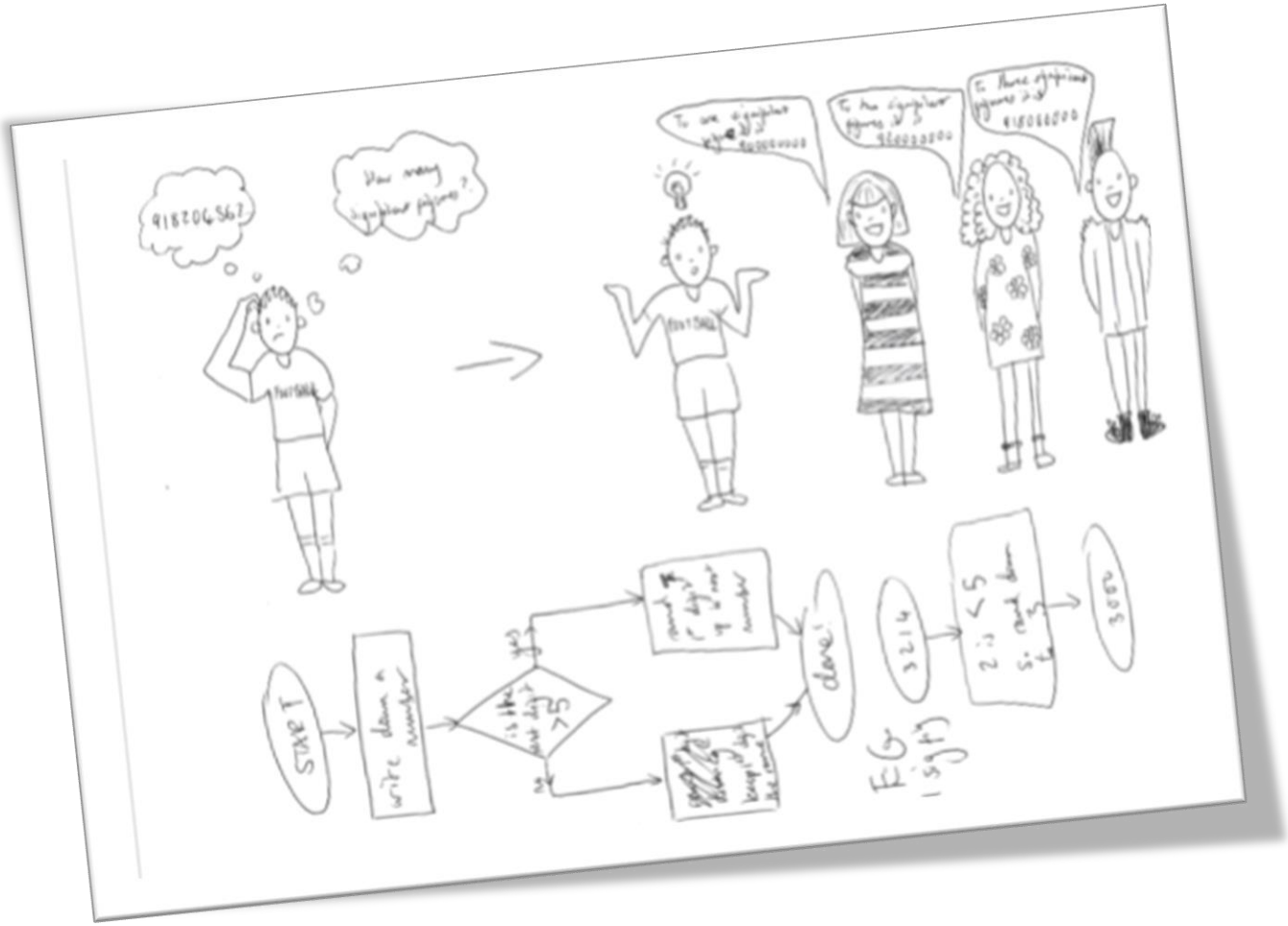
Name of creator		
Criteria	Your comment	Score 1, 2, 3, 4 or 5
Fun!		
Clear maths message		
Visual appeal		
Makes you laugh		
Total Score out of 20		

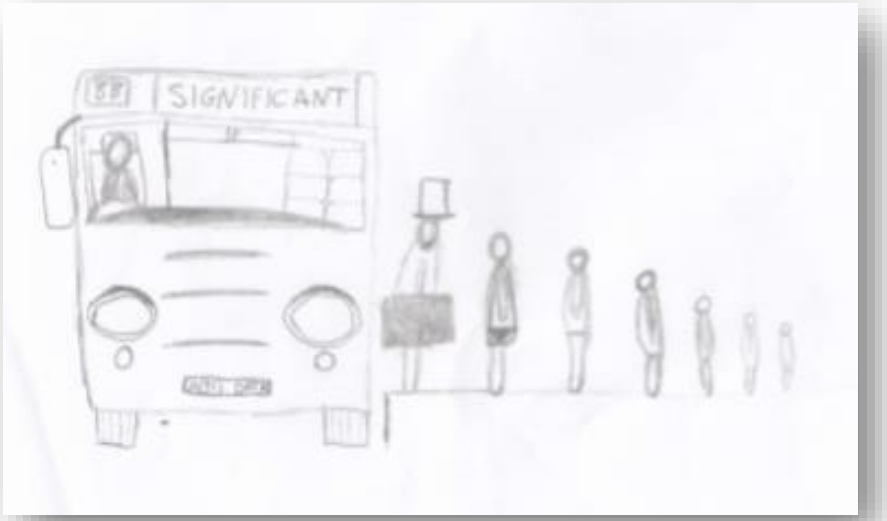
2018--19

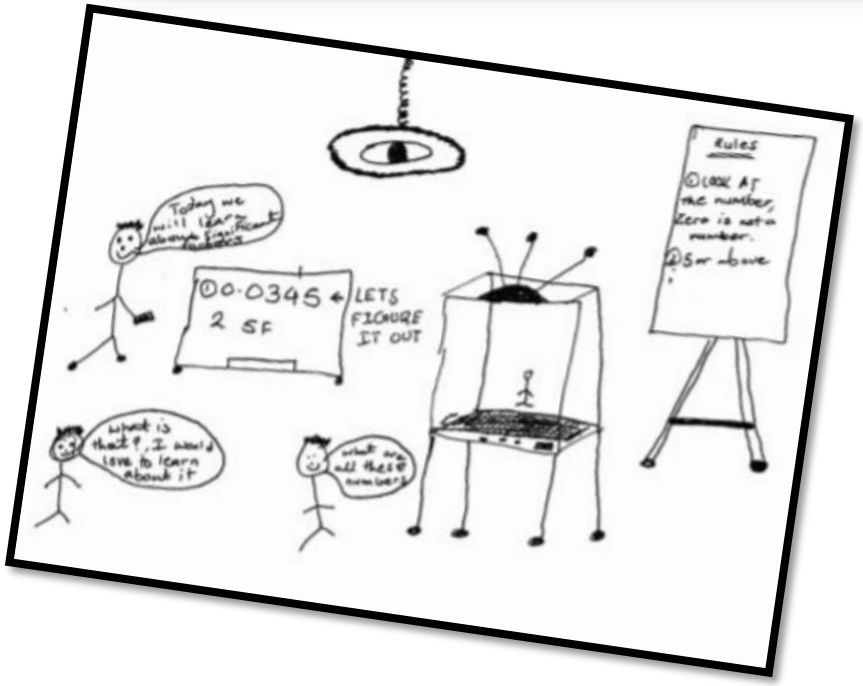
Talking …

S.T.E.A.M

From graphics to …







… prose

to …dialogue

to …

Decimal Places

To work 'out decimal places
As Beyoncé say's put a ring on it!
Take that number and look beyond
To work out if it goes up or down

For example you have diamonds in a ring
Each diamond is 9.18273645 carats.

Problem: $x + \square = 10$

Me	Dog
- Help!	- What's up?
- I can't work this out!	- What's in the box?
- I don't know! That's what I need to work out!	- Well what do you add to x to equal 10?
- If I knew that I would be asking for help!	- Well what about adding a bone? Bones are the best answer to everything!
- Stop thinking with your stomach and help!!	- ok, ok. So why don't you work out what x equals?

… learning interactions

Williamson, B., (2015). A five-cycle living visual taxonomy of learning interactions.

Educational Journal of Living Theories, *8*(2).

to…capturing student dialogue real-time!

Brian's Support Group!
Abdul, Abdullah 1807993, Ahmad, Ahmad, Ahmael 180

Ahmael 1802613 Y0 2018
I love maths ❤️❤️ 09:48

Ahmad 1705846 2018
Maths love you too 09:49

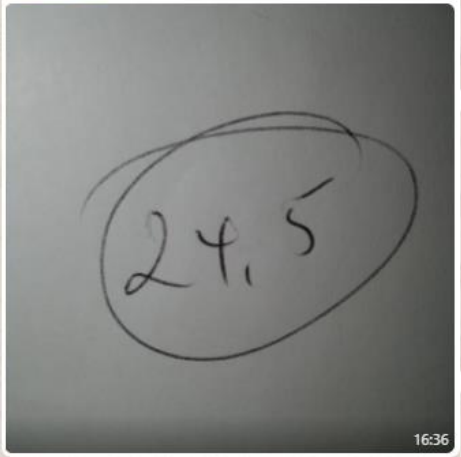
Jack 1809019 "y0 2018
What's maths 09:50

Ibrahim 2018

Example	Engineer Thinks	Mathematician Thinks	
log(50)	$\log_{10}(50)$	$\log_e(50)$	confusion
ln(50)	$\log_e(50)$	$\log_e(50)$	no confusion
$\log_{10}(50)$	$\log_{10}(50)$	$\log_{10}(50)$	no confusion

So, be careful when you read "log" that you know what base they mean!

Kennedy YO



Franklin
Ibrahim 2018
Photo
Getting it right already. 19:11

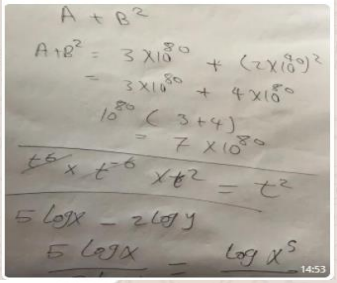
Ibrahim 2018
Ibrahim 2018
Photo
Brian what do you think about the statement regarding the green line??? 19:17

I think the engineer and the mathematician think the same about log. It means base 10. It's Ln that means base e. 19:20 ✓

Richard 1804059 2018
Bro the guy is sleeping let him rest 19:16

Suha 1808185 Y0 2018
🤔 19:17

Name Not Known



I really hope he is fine

Brian always answer. This unusual. 19:21

Richard 1804059 2018
I thinking he spending some time with his family

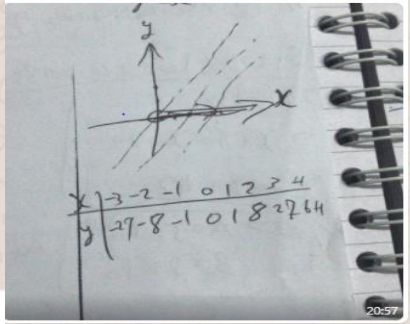
He can't be on his phone every min 19:22

Suha 1808185 Y0 2018
You are right 19:22

No problem 19:22

Only checking 19:23

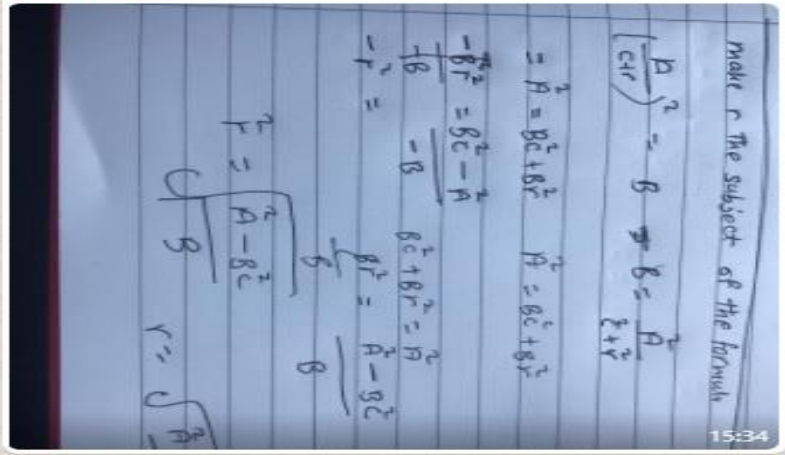
Sef Al Kaeed YO



Richard 1804059 2018
That's good man he will be back active tomorrow 19:24

Mulark 2018
Haha 15:33

Mulark 2018

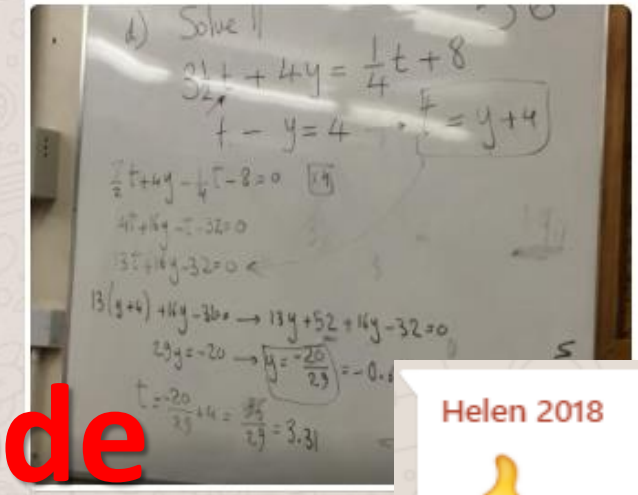


Mihai Y0, 2818
Yes adams i think now is correct 15:35

No Mubark i think the last picture with adams ressult is ok

Question 12 is easy 15:37

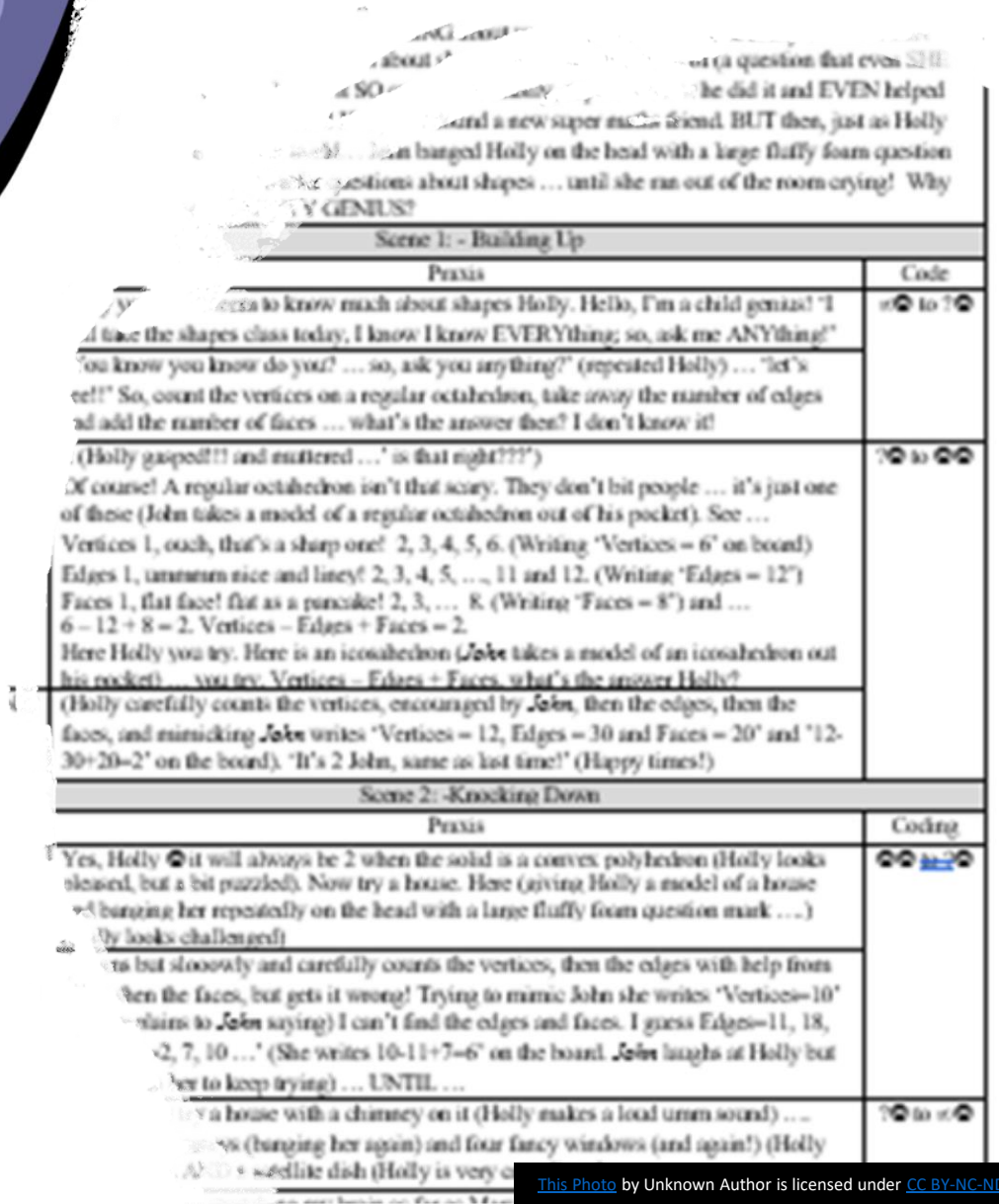
James 1808795



Helen 2018
👍 13:59

Praxis to code

Code to praxis



Scene 1: - Building Up	
Praxis	Code
y … to know much about shapes Holly. Hello, I'm a child genius! 'I … time the shapes class today, I know I know EVERYthing; so, ask me ANYthing!'	🤔 to ❓🤔
'ou know you know do you? … so, ask you anything?' (repeated Holly) … 'let's ee!!' So, count the vertices on a regular octahedron, take *away* the number of edges nd add the number of faces … what's the answer then? I don't know it!	
(Holly gasped!!! and muttered …' is that right???') Of course! A regular octahedron isn't that scary. They don't bit people … it's just one of these (John takes a model of a regular octahedron out of his pocket). See … Vertices 1, ouch, that's a sharp one! 2, 3, 4, 5, 6. (Writing 'Vertices = 6' on board) Edges 1, umuum nice and liney! 2, 3, 4, 5, … , 11 and 12. (Writing 'Edges = 12') Faces 1, flat face! flat as a pancake! 2, 3, … 8. (Writing 'Faces = 8') and … 6 – 12 + 8 = 2. Vertices – Edges + Faces = 2. Here Holly you try. Here is an icosahedron (**John** takes a model of an icosahedron out his pocket) … you try. Vertices – Edges + Faces, what's the answer Holly?	❓🤔 to 🤔🤔
(Holly carefully counts the vertices, encouraged by **John**, then the edges, then the faces, and mimicking **John** writes 'Vertices = 12, Edges = 30 and Faces = 20' and '12-30+20=2' on the board). 'It's 2 John, same as last time!' (Happy times!)	
Scene 2: -Knocking Down	
Praxis	Coding
Yes, Holly 🤔 it will always be 2 when the solid is a convex polyhedron (Holly looks pleased, but a bit puzzled). Now try a house. Here (giving Holly a model of a house … bunging her repeatedly on the head with a large fluffy foam question mark …) … ly looks challenged)	🤔🤔 to 2🤔
… s but slooowly and carefully counts the vertices, then the edges with help from … hen the faces, but gets it wrong! Trying to mimic John she writes 'Vertices=10' … claims to **John** saying) I can't find the edges and faces. I guess Edges=11, 18, … 2, 7, 10 …' (She writes 10-11+7=6' on the board. **John** laughs at Holly but … er to keep trying) … UNTIL …	
… a house with a chimney on it (Holly makes a loud umm sound) … … s (bunging her again) and four fancy windows (and again!) (Holly … satellite dish (Holly is very c…	❓🤔 to 🤔🤔

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