

**WEST AFRICAN EXAMINATIONS  
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**PERFORMANCE IN MATHEMATICS AND  
SCIENCE: BREAKING THE 'JINX'**

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# Order of Presentation

- 1. Achievement motivation**
- 2. Relevance of science and mathematics to national (and global) development**
- 3. Students' performance in science and mathematics**
- 4. Challenges in the delivery of the science and mathematics curricula**
- 5. Breaking the jinx**
- 6. Conclusion**



# **Attribution Theory of Achievement Motivation and Emotion.**

**According to Weiner's attribution theory, the causes individuals attribute to events have an impact on the way they cognitively, affectively, and behaviourally respond on future occasions (Weiner, 1986, 2005).**

**Four attributions are typically identified in the literature:**

- **attribution to luck**
- **attribution to task difficulty**
- **attribution to ability**
- **attribution to effort.**



# Application of the Theory

**Failure in an examination may be attributed to**

- **bad luck**
- **difficult questions**
- **low ability**
- **insufficient effort.**

**These causal attributions can also be mapped according to their locus, stability, and how they can be controlled (Weiner, 1992). The control dimension tends to be a significant determinant of students' responses to setback, pressure, and fear of failure (Borkowski, Carr, Rellinger, & Pressley, 1990).**



# Implication for Educational Practice

**The control dimension can have two main effects:**

- a) It affects the observer's emotions directly.**
- b) Observers' inferences about the cause of an event can shape the actor's emotions and behaviour.**

## **Examples**

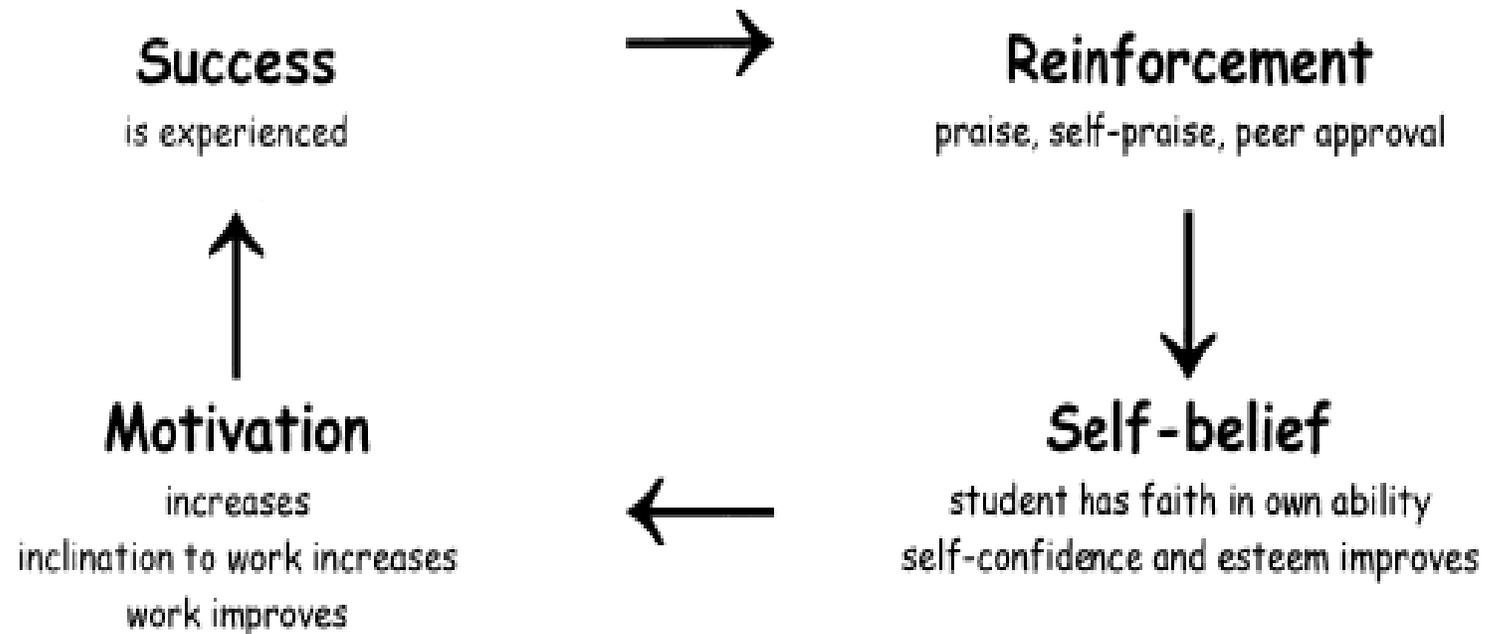
***a) A teacher attributing a student's success to effort can experience positive feelings of admiration for that student. On the other hand, attributing poor performance to a lack of ability may evoke negative feelings of shame in that student.***

***b) A student whose performance has been criticised by a teacher because of perceived lack of ability is likely to put in less effort on subsequent occasions. On the other hand, a student whose success is acknowledged by his/her teacher, is more likely to put in more effort on subsequent occasions.***



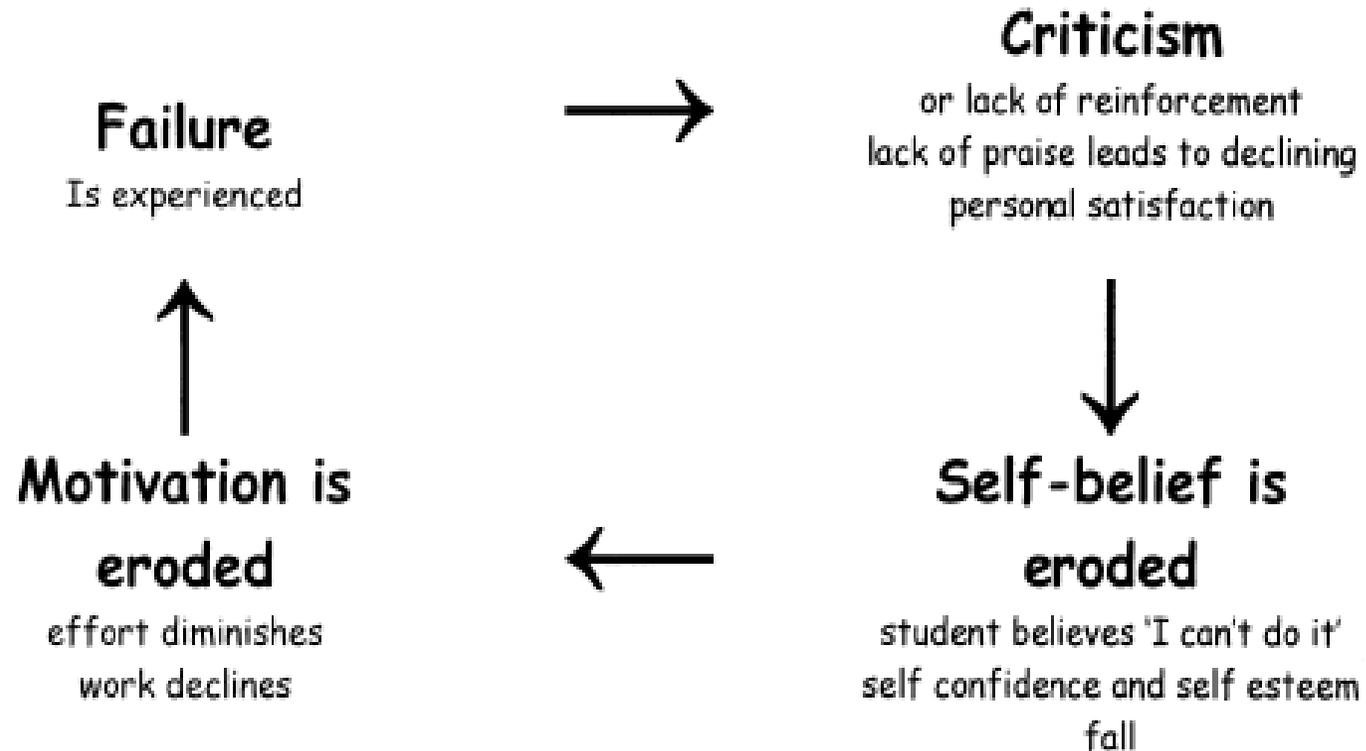
# Success Breeds Success

## *The virtuous circle*

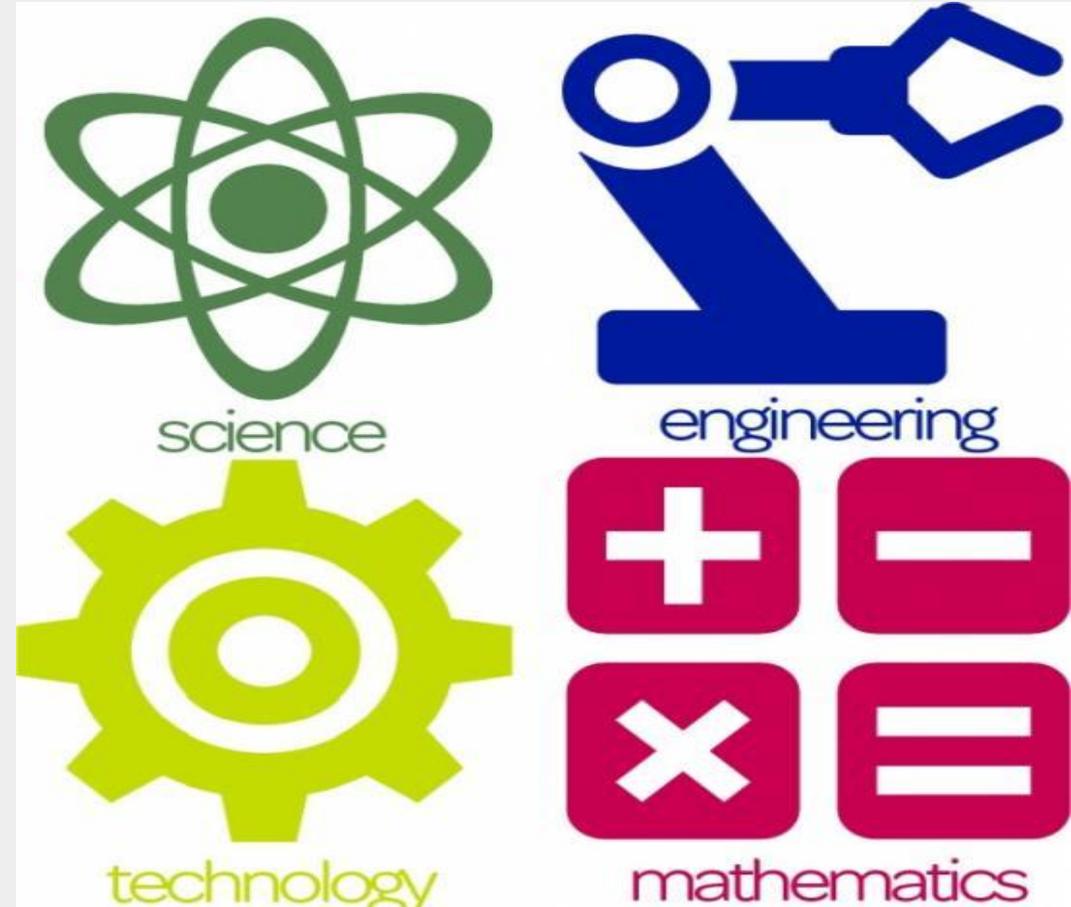


# Failure Breeds Failure

## *The vicious circle*



# Relevance of Mathematics and Science to National Development



# Relevance of Mathematics and Science to National Development

**WASHINGTON, DC (1<sup>st</sup> July, 2015)**

**President Obama today named 108 mathematics and science teachers as recipients of the prestigious Presidential Award for Excellence in Mathematics and Science Teaching.**

**"These teachers are shaping America's success through their passion for math and science....their leadership and commitment empower our children to think critically and creatively about science, technology, engineering, and math. The work these teachers are doing in our classrooms today will help ensure that America stays on the cutting edge tomorrow."**



# Relevance of Mathematics and Science in National Development

**LONDON (8<sup>th</sup> December, 2014). PRESS RELEASE!**

**“Maths and science must be the top priority in our schools” - Prime Minister**

**The Prime Minister, David Cameron, said:**

**“There’s no secret to success in the modern world. If countries are going to win in the global race and children compete and get the best jobs, you need mathematicians and scientists – pure and simple. So today, we commit to deliver more maths and science teachers.**

**This is all part of our long-term economic plan for Britain – making sure our children have the skills they need to thrive and get on. And by sticking to it, we will lift our children’s horizons and pull our country up in the world.”**

**(Department for Business, Innovation and Skills, 2014)**



# Relevance of Mathematics and Science in National Development

**(BEIJING 10<sup>th</sup> June, 2014) President Xi Jinping:**

**“One of the key elements in the ‘new normal’ is to increase productivity in the Chinese economy through technological advances. These advances can only come through technical innovations, the result of human creativity....Our scientists and engineers should bravely shoulder their responsibilities, overtake others, and find the right direction, to which they should stick...They should have the courage and confidence to blaze new trails, overcome difficulties and seek excellence, and audaciously make world-leading scientific and technological achievements”**

**(Conference of China's Top Academies for Science and Engineering, 2014)**



# General Application of Science and Mathematics

- 1. Solving problems**
- 2. Balancing the diversity of living and non-living things**
- 3. Adopting sustainable habits for managing the natural environment**
- 4. Using appliances and gadgets effectively**
- 5. Optimising the use of energy**
- 6. Preventing diseases**
- 7. Taking decisions based on scientific rules rather than on superstition**
- 8. Enhancing GDP (Turning skills and good health into improved national wealth)**



# Student Performance in Science and Mathematics

- 1. Primary school pupils' performance in mathematics in the Ghana 2013 National Education Assessment**
- 2. Senior high school students' performance in the West African Secondary School Certificate Examination (WASSCE) in mathematics and science over a period.**

**Results from the two show that Ghanaian pupils/ students struggle when it comes to demonstrating application of mathematical and scientific concepts.**

**Conclusion: There is a problem that needs fixing!**



# **Ghana 2013 National Education Assessment (NEA)**

**The NEA tests are based on national curricula and are made up of 30 to 40 multiple choice questions.**

**Mathematics and English tests were taken by P3 and P6 pupils in 550 schools (55 selected from each of the 10 regions)**

**Five domains tested in mathematics in the 2013 NEA were:**

- **Numbers and Numerals**
- **Basic Operations**
- **Measurement**
- **Shape and Space**
- **Collect and Handle Data**



# Ghana 2013 NEA Results

- **Pupils who scored 35% on the test were seen as having minimum competency in the subject and pupils who scored 55% or better were seen as having proficiency.**
- **For P6 mathematics, only approximately 11% of the pupils reached proficiency, versus 22% in P3.**
- **For *both* P3 and P6, approximately 40% of the pupils failed to achieve even minimum competency in mathematics**
- **Pupils demonstrated the most difficulty with tasks in the Measurement/Shape and Space domain, for both P3 and P6.**
- **P3 pupils, but not P6, also had low scores in the Collect and Handle Data domain.**
- **These findings were similar to those obtained in 2011**



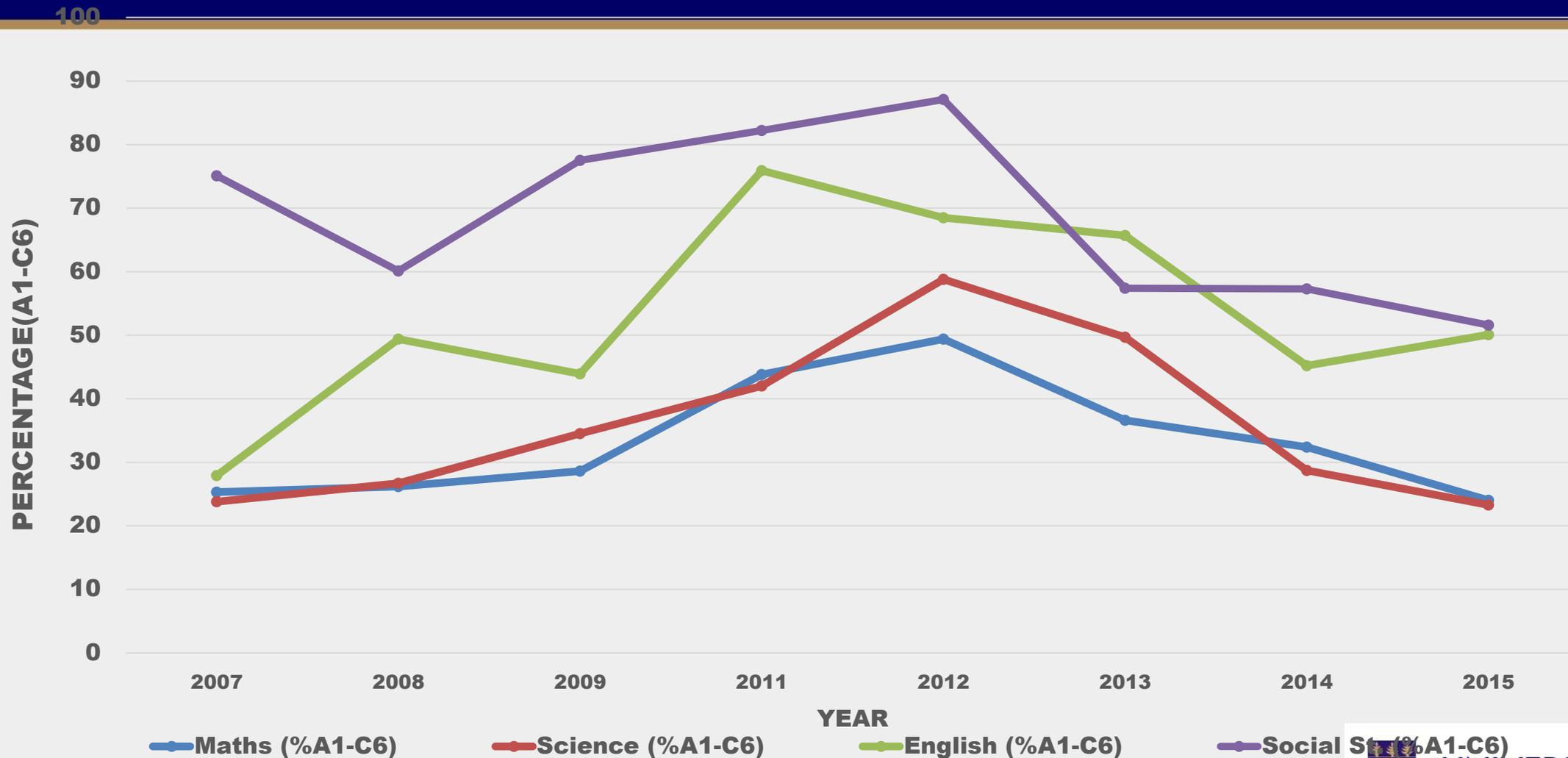
# Table 1: WASSCE (MAY – JUNE) RESULTS IN CORE SUBJECTS FROM 2007 TO 2015 (A1 –C6)

SUBJECT	2007	2008	2009	2010	2011	2012	2013	2014	2015
• English	37 158	67, 412	68,854	-	122,699	108,633	267,504	108,633	133,972
Language	27.9%	49.4%	43.9%		75.9%	68.5%	65.7%	45.2%	50.1%
• Integrated	31,659	36, 179	54,113	-	62,308	98,603	202,636	68.965	62,374
<b>Science</b>	<b>23.8%</b>	<b>26.7%</b>	<b>34.5%</b>		<b>42.0%</b>	<b>56.8%</b>	<b>49.7%</b>	<b>28.7%</b>	<b>23.3%</b>
• Core	33, 639	35,536	44,934	-	65,005	77,882	149,612	77,884	64,268
<b>Mathematics</b>	<b>25.3%</b>	<b>26.2%</b>	<b>28.6%</b>		<b>43.8%</b>	<b>49.4%</b>	<b>36.6%</b>	<b>32.4%</b>	<b>24.0%</b>
• Social		100,819	82,081	121,558	-	121,993	137,714	331,255	137,714
137,839									
Studies	75.1%	60.1%	77.5%		82.2%	87.1%	57.4%	57.3%	51.6%

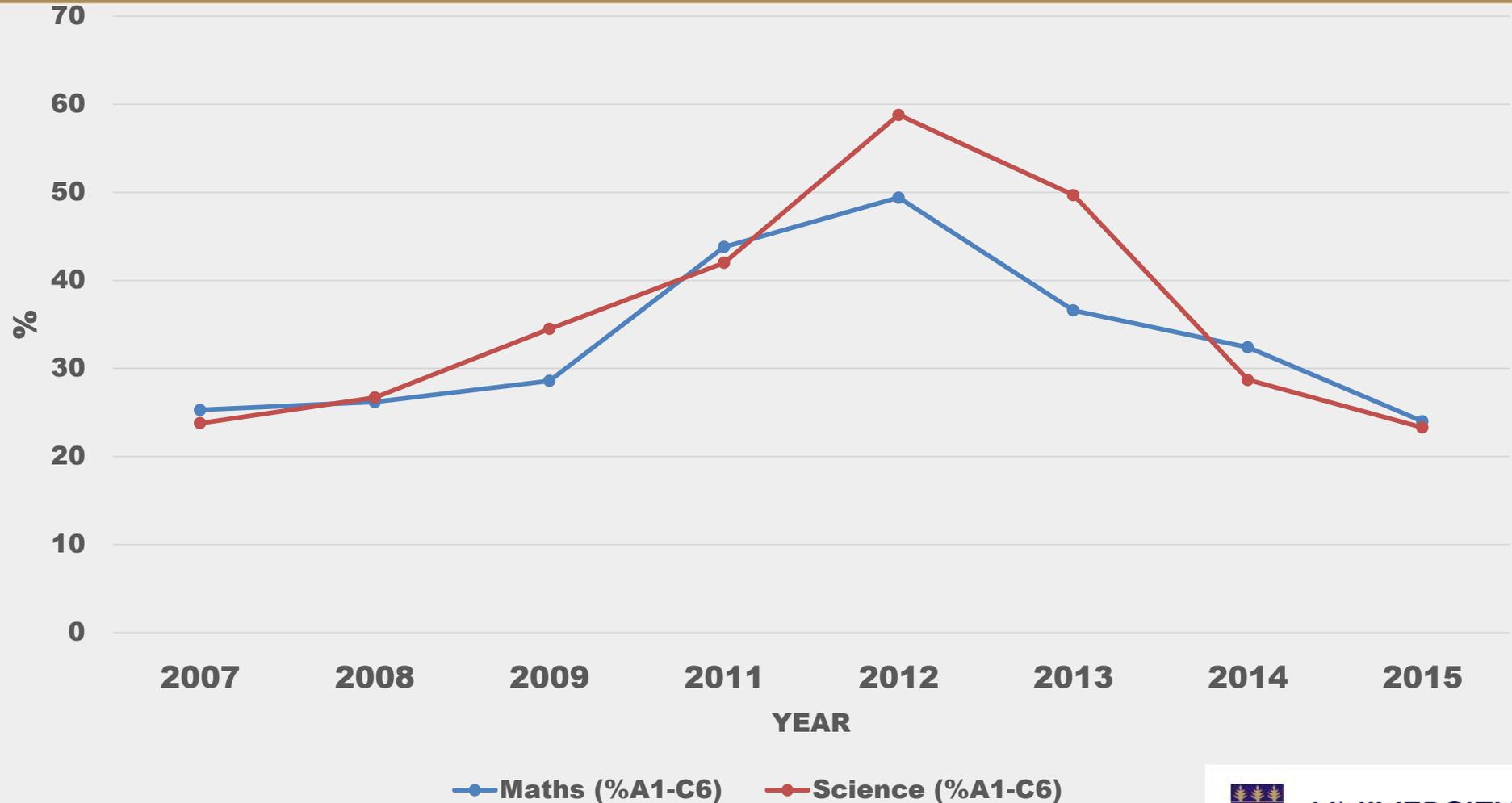
Source: WAEC, 2015



# STUDENTS' PERFORMANCE IN CORE SUBJECTS IN WASSCE: 2007-2015



# STUDENTS' PERFORMANCE IN MATHEMATICS AND SCIENCE IN WASSCE: 2007-2015



# Factors affecting the delivery of the science and mathematics curricula

**Factors include, but not limited to the following:**

- **Weak computational skills lower student performance in mathematics at all levels**
- **Students' low self-confidence in their ability to do mathematics and/or science**
- **Excessive use of didactic approaches to the teaching of mathematics and science does not help students to grasp relevant concepts firmly**
- **Limited use of learning resources in mathematics and science classrooms**
- **Limited number of qualified mathematics and science teachers**
- **Unqualified teachers' weak *content* and/or *pedagogical content knowledge* in mathematics and science**
- **Teaching to the test – some teachers select a few topics and concentrate on these**
- **Students do not invest enough time in the study of mathematics and science**
- **Students do not prepare well for examinations generally**



# Breaking the Jinx

1. **Catch them young (follow the Chinese example – contextualise it!)**
2. **Make lessons challenging, active, learner centred and **MOTIVATING****
3. **Be creative and innovative (e.g. use technology appropriately)**
4. **Encourage students to spend more time on maths & science tasks**
5. **Prepare students well (and legally) for examinations**
6. **Guide students to build self-confidence in maths and science**
7. **Continue with effort by government and non-government organization to promote science and mathematics (e.g. T-TEL)**
8. **Institute ‘special allowances’ for qualified mathematics/science teachers and link these allowances to performance**
9. **Institute Primary Mathematics & Science Quiz Competitions (at District/Municipal/Metropolis, Regional and National levels)**



# COOPERATIVE SMALL GROUPWORK?



# STAYING CALM IN THE MATHS & SCIENCE CLASSROOM

- **Challenging** – lessons with a range of activities flexible enough to ‘stretch’ the thinking/imagination of learners across the ability range.
- **Active** – lessons in which learners are actively engaged and do not remain passive recipients of information.
- **Learner-centred** – lessons in which learners' independent thinking skills develop as fully as they should because their learning is not restricted to what the teacher has decided they need to learn.
- **Motivating** – lessons with interesting/fun activities that engage students and support their growing understanding and knowledge



# Evaluating Mathematical and Scientific Statements

**Learners decide whether given statements are ‘always true’, ‘sometimes true’ or ‘never true’. They are encouraged to develop rigorous mathematical and scientific arguments and justifications, and to devise examples and counterexamples to defend their reasoning.**

## **Examples**

- 1. If a square and a rectangle have the same perimeter, the square has a smaller area.**
- 2. If you draw the two diagonals of a trapezium, the shape is split into 4 parts and exactly 2 of the parts are equal in area.**
- 3. A force in motion is a function of time**
- 4. Bacteria multiply**
- 5. Hydrocarbons are composed only of the elements carbon and hydrogen**



# PASSIVE LEARNERS?



# TIME ON TASK IN THE SCIENCE LAB?



# BETTER!



# CONCLUSION

- 1. Providing opportunities for pupils to study mathematics and science in rich learning environments can boost their confidence and interest in these subjects so they become good problem solvers at an early age.**
- 2. Exposing pupils in the primary school to quality literacy and numeracy learning activities will enhance their learning of science because they will understand science tasks better and identify which numeracy techniques are required to deal with these tasks.**
- 3. Teachers and their supervisors hold the key to both doors 1 & 2!**



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**THANK YOU!**

