Proving what is thought – **The efficacy of MCQs**

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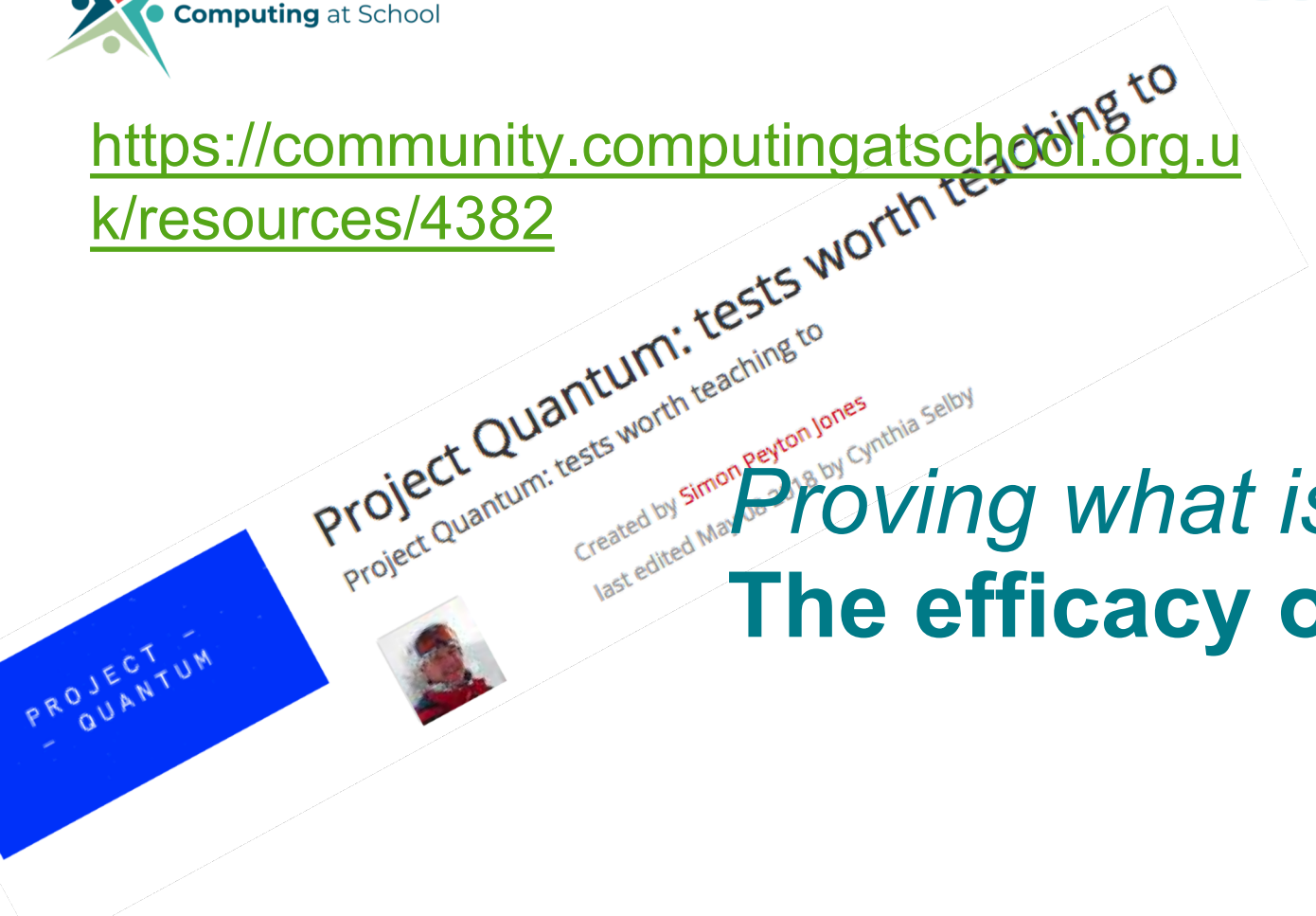
Computing at School

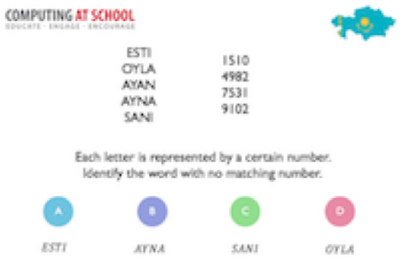
UNIVERSITY OF Southampton

https://community.computingatschool.org.uk/resources/4382



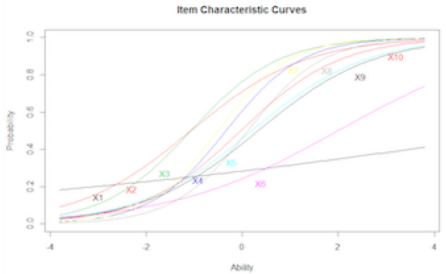
Proving what is thought – **The efficacy of MCQs**

Efficacy of MCQs - overview



Quantum Project
x4 MCQs - good or bad
computational thinking ???
how do we know?

Item Response Theory
N = 755



then comparing with other measures

developing conclusions…

MCQ#1

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$	}	1
₸		5
£		3

Each symbol is represented by a certain number. Identify the correct combination of numbers to represent

£ £ ₸
₸ $ ₸
$ ₸ £

A

5 5 3
3 1 3
3 1 5

B

5 5 1
1 3 1
3 1 5

C

5 3 1
1 3 1
3 5 1

D

5 5 1
1 3 1
5 1 3

MCQ#2

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ESTI	1510
OYLA	4982
AYAN	7531
AYNA	9102
SANI	

Each letter is represented by a certain number.
Identify the word with no matching number.

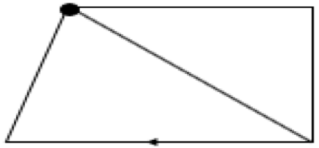
A *ESTI*

B *AYNA*

C *SANI*

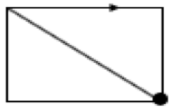
D *OYLA*

MCQ#3

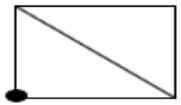


Which of the followings is similar to the one given above?

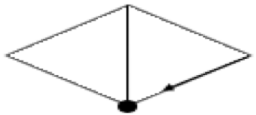
A



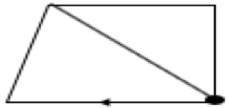
B



C

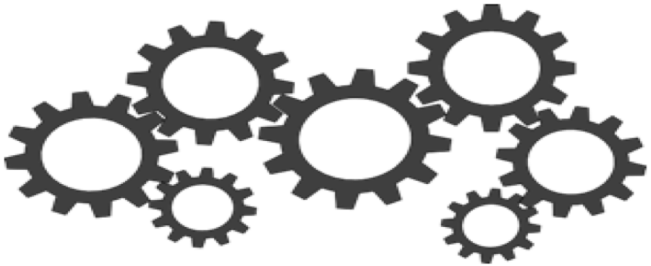


D



MCQ#4

A, B, C and D are cogs and are interconnected.
1) When A turns clockwise, so does C.
2) C is joined to B.
3) D turns opposite to A.
Identify the true statement, when D turns clockwise?



A C turns clockwise, A turns anticlockwise.

B C turns anticlockwise, B turns clockwise.

C C and B turn anticlockwise.

D A and B turn anticlockwise.

MCQ#1 X5

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$ ₸ £ } 1 5 3

Each symbol is represented by a certain number. Identify the correct combination of numbers to represent

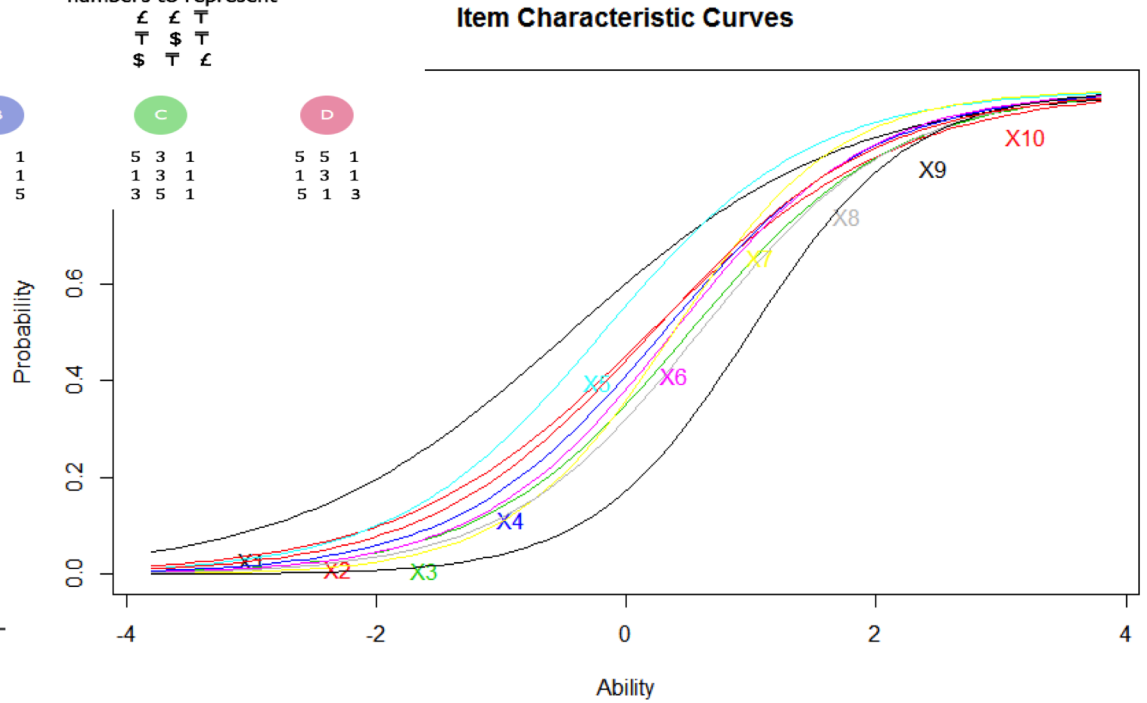
£ £ ₸
₸ $ ₸
$ ₸ £

A
5 5 3
3 1 3
3 1 5

B
5 5 1
1 3 1
3 1 5

C
5 3 1
1 3 1
3 5 1

D
5 5 1
1 3 1
5 1 3



B

MCQ#2 X8

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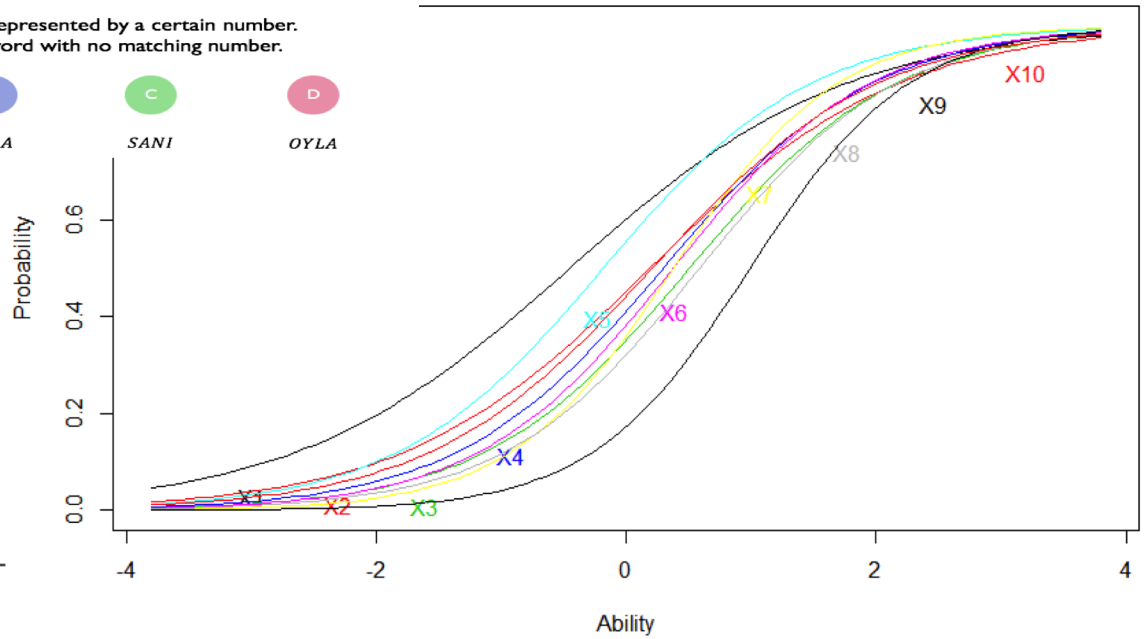
ESTI	1510
OYLA	4982
AYAN	7531
AYNA	9102
SANI	

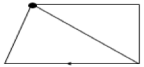
Each letter is represented by a certain number.
Identify the word with no matching number.

A *ESTI* B *AYNA* C *SANI* D *OYLA*



B

MCQ#3 X1

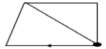


Which of the followings is similar to the one given above?

A 

B 

C 

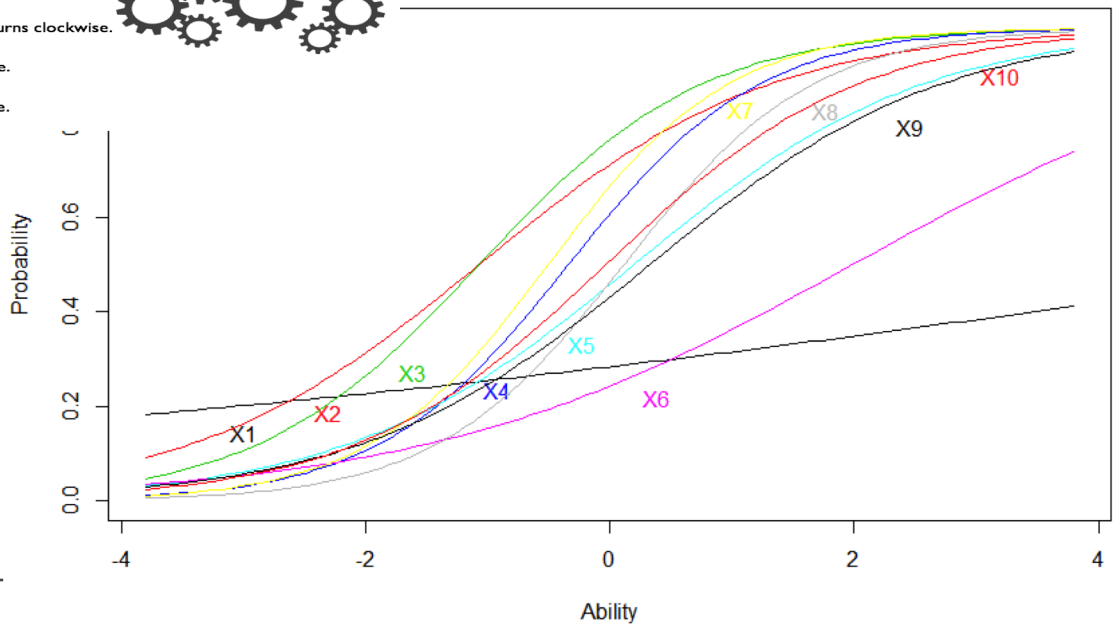
D 

A

MCQ#4 X9

A, B, C and D are cogs and are interconnected.
1) When A turns clockwise, so does C.
2) C is joined to B.
3) D turns opposite to A.
Identify the true statement, when D turns clockwise?

A. C turns clockwise, A turns anticlockwise.
B. C turns anticlockwise, B turns clockwise.
C. C and B turn anticlockwise.
D. A and B turn anticlockwise.



B

What is IRT?

- Item Response Theory
- Analysis paradigm
- Relationship between item performance and general performance level of the individual
- Uses probability

"Item Response Theory (IRT) is a paradigm for the design analysis and scoring of test instruments that measures attitudes, abilities and other variables. This theory is based on the relationship between person's performance on a test item and the person's performance level on an overall measure of the ability the item was constructed to measure. IRT is based on a mathematical model, which describes in probabilistic terms, how a test taking person with a higher standing on a trait is likely to respond in a different response category to a person with a low standing on the trait (Ostini & Nering, 2006). IRT has several advantages over traditional test theory, such as, sample independency, measurement of range of different abilities, accounting item difficulty, accounting for guessing, and supporting adaptive testing (Thissen & Wainer, 2001)."

Ostini, R., & Nering, M. (2006). *Polytomous Item Response Theory Models*. California: SAGE Publications Ltd.

Thissen, D., & Wainer, H. (2001). *Test Scoring*. New Jersey: Lawrence Erlbaum Associates.

Mindetbay, Y., Bokhove, C., & Woollard, J. (2019) The measurement of computational thinking performance using multiple-choice questions, *Computational Thinking Education* (submitted/accepted)

Overall study

- The full study investigates the relationship between ***computational thinking performance*** and general ***school achievement*** and explores if computational thinking performance ***can be predicted*** by algebra and informatics achievement.
- N = 775 grade 8 students from 28 secondary schools across Kazakhstan
- Computational Thinking Performance ***test*** of 50 multiple-choice questions (Project Quantum Diagnostic Questions Eedi platform)
- Computational Thinking Scale ***questionnaire***
- Test: logical thinking, generalisation and abstraction
- Questionnaire: creativity, algorithmic thinking, cooperation, critical thinking and problem solving
- Secondary data: school achievement results across a number of school subjects

Computational thinking questionnaire

I like people who are very sure of their decisions.

I have the belief that I can solve the problems that may arise when I encounter a new situation.

When I plan to solve a problem, I am confident that I can carry out the plan.

When I face a problem, before I move on to another topic, I think about the problem.

I can immediately start the equation to solve a problem.

I think that it is easier to learn the expressions made with the aid of mathematical symbols and concepts.

I cannot apply the solutions I have designed in a gradual manner.

I cannot produce too many options when thinking about possible solutions to a problem.

I cannot develop my own thinking in a collaborative learning environment.

It makes me tired of trying to teach my group friends something in a collaborative learning environment.

Extract from

Preliminary results…

Computational Thinking Performance test showed a high degree of reliability.

- 3 questions were rated poor in terms of efficacy
- Internal consistency of results was high
- Comparative consistency of results was high

Algebra ***and*** general school achievement was a significant predictor of computational thinking performance.

Students' ***perception*** of their computational thinking skills had a significant correlation with their computational thinking performance.

No gender difference noted in computational thinking performance and perceptions of computational thinking.