How might diagnostic assessments be used to support teaching and learning in higher education?

BY DARLINGTON MUTAKWA & ROBERT PRINCE

Background

The National Benchmark Tests Project (NBTP) was commissioned in 2005 by Higher Education South Africa (HESA), now called Universities South Africa (USAf).

The main objective of the project was to assess the entry level academic skills of candidates in **Academic Literacy (AL), Quantitative Literacy (QL) and Mathematics (MAT).**

The National Benchmark Tests (NBTs) are designed to provide complementary **criterion-referenced information** to supplement **norm-referenced school-leaving** results such as those provided by the **National Senior Certificate (NSC).**

Test Domains: Academic Literacy

The National Benchmark Test in Academic Literacy aims to assess candidates' ability to:

- **read carefully and make meaning from texts** that are typical of the kinds that they will encounter in their studies;
- **understand vocabulary**, including vocabulary related to academic study, in their contexts; identify and track points and claims being made in texts.
- **understand and evaluate the evidence that is used to support claims made by writers of texts**; extrapolate and draw inferences and conclusions from what is stated or given in text;
- **identify main from supporting ideas** in the overall and specific organisation of a text;
- identify and understand the different types and purposes of communication in texts;
- be aware of and identify text differences that relate to writers' different purposes; audiences, and kinds of communication.

Test Domains: Quantitative Literacy

The National Benchmark Test in Quantitative Literacy aims to assess candidates' ability to:

- **competently interpret quantitative information.**
- apply quantitative procedures in various situations;
- formulate and apply simple formulae;
- **read and interpret tables, graphs, charts and text** and integrate information from different sources; and
- accurately **do simple calculations** involving multiple steps;
- identify trends and patterns in various situations;
- **reason logically**;

Test Domains: NBT Mathematics

The National Benchmark Test in mathematics, referred to as the NBT MAT test, aims to assess candidates' ability with respect to a number of mathematical topics:

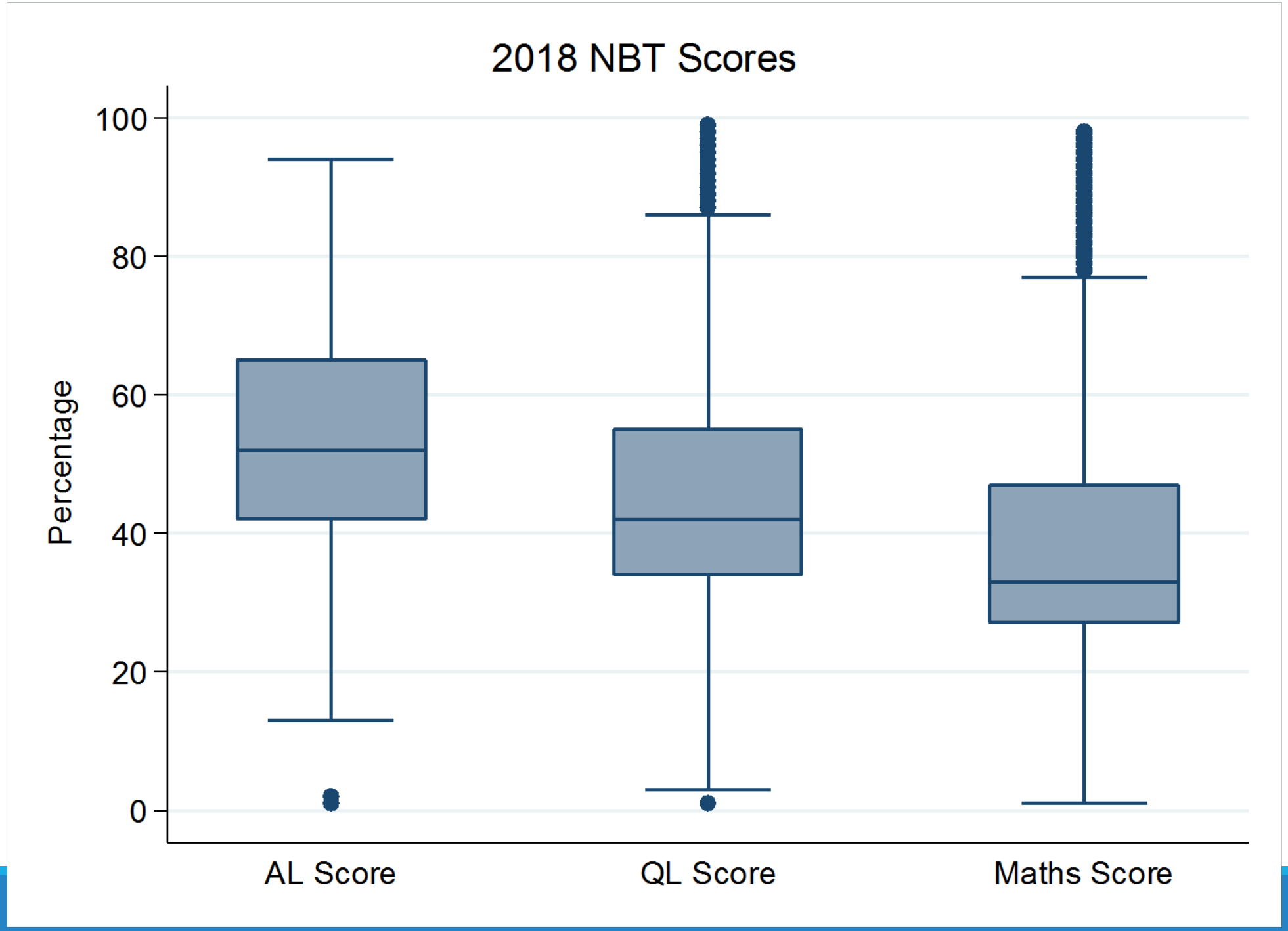
- **Problem solving and modelling**, requiring the use of algebraic processes, as well as understanding and using functions represented in different ways.
- **Basic trigonometry,** including graphs of trigonometric functions, problems requiring solution of trigonometric equations and application of trigonometric concepts.
- **Spatial perception** (angles, symmetries, measurements, etc.), including representation and interpretation of two and three dimensional objects; analytic geometry and circle geometry.
- **Data handling and probability**.
- **Competent use of logical skills**.

Description of 2018 Cohort

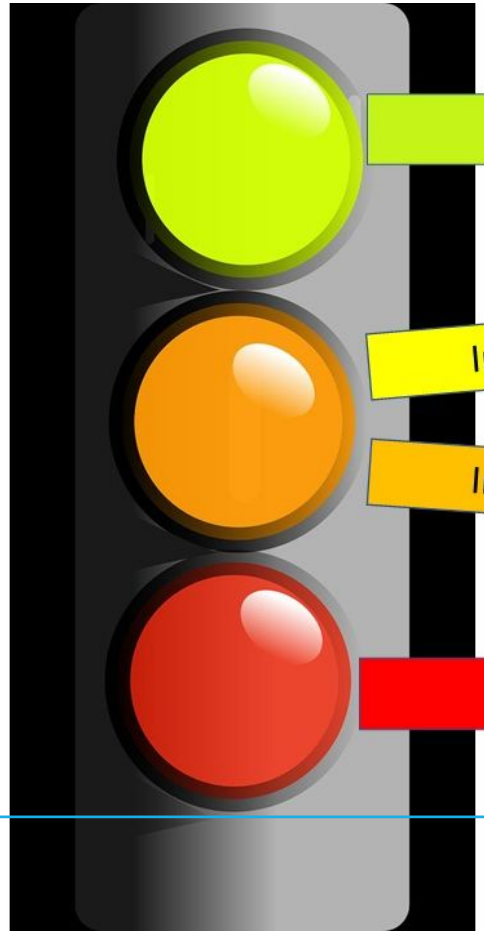
The sample consisted of test scores for **85 024** Academic Literacy (AL), **85 083** Quantitative Literacy (QL) and **63 048** Mathematics (MAT) candidates who wrote the National Benchmark Tests (NBT) for admission into South African Higher education in 2018.

The cohort consisted of approximately **60%** women; **66%** self-identified themselves as black and **17%** as white;

Approximately **95%** self-identified as South African citizens and approximately **28%** reported English as their home language.


2018 NBT Scores
Percentage
100
80
60
40
20
0
AL Score
QL Score
Maths Score

NBT Benchmark Levels



Proficient

Performance in domain areas suggests that academic performance will not be adversely affected.
If admitted, students should be placed on regular programmes of study.

Intermediate Upper

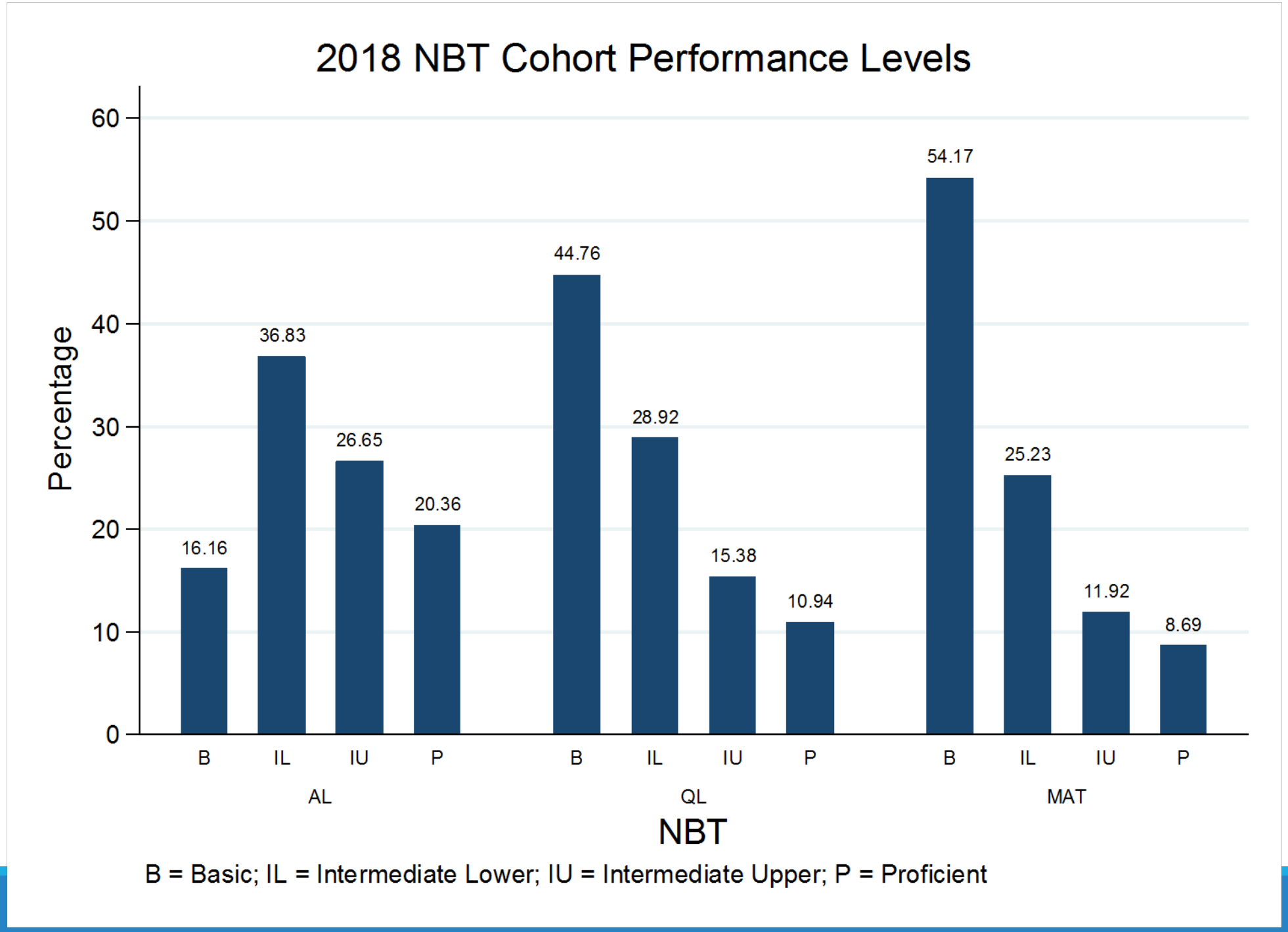
Students are likely to need complementary support (additional tutorials, workshops, augmented courses, language-intensive work).

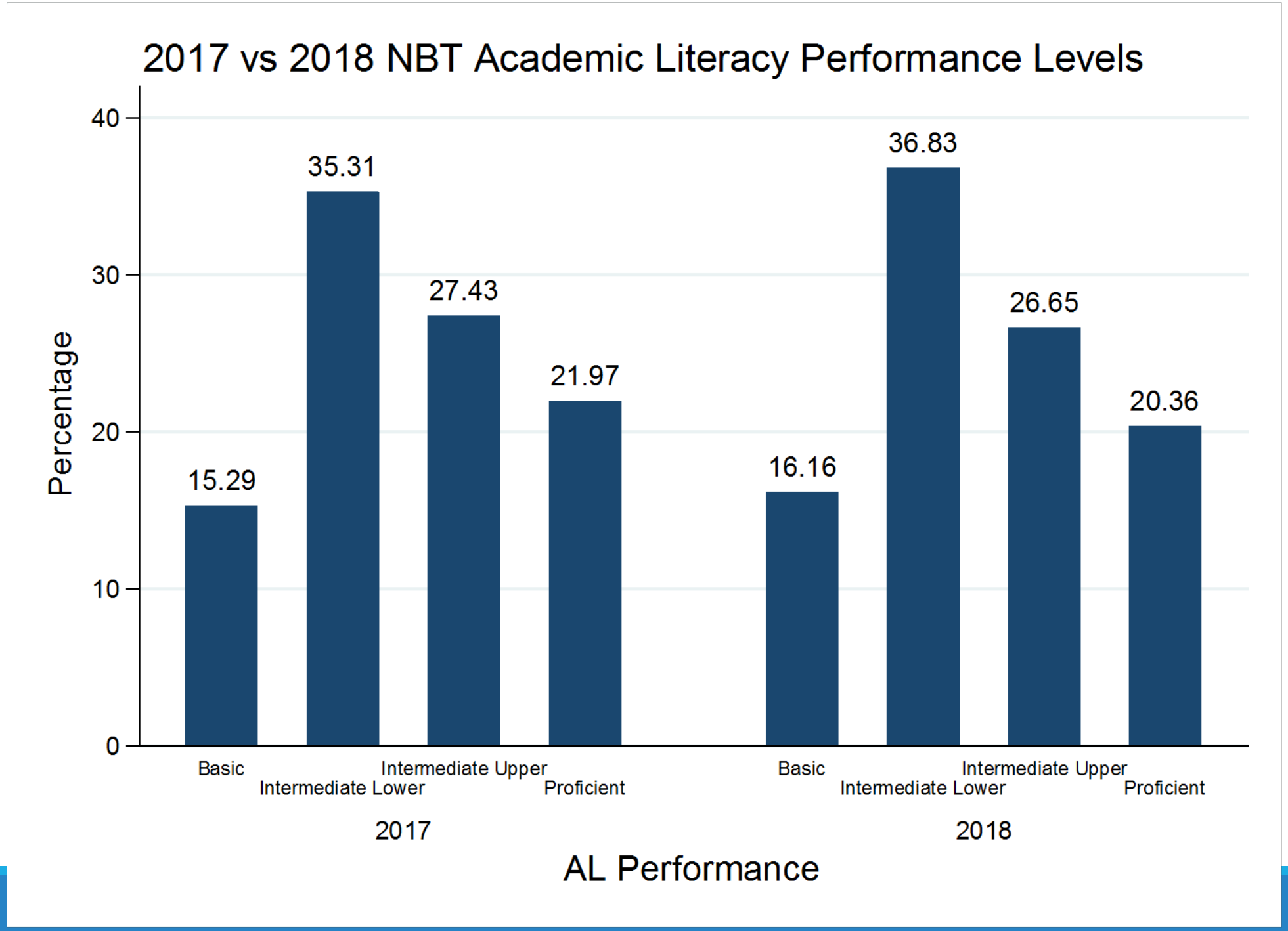
Intermediate Lower

Students need to be placed in an extended programme.

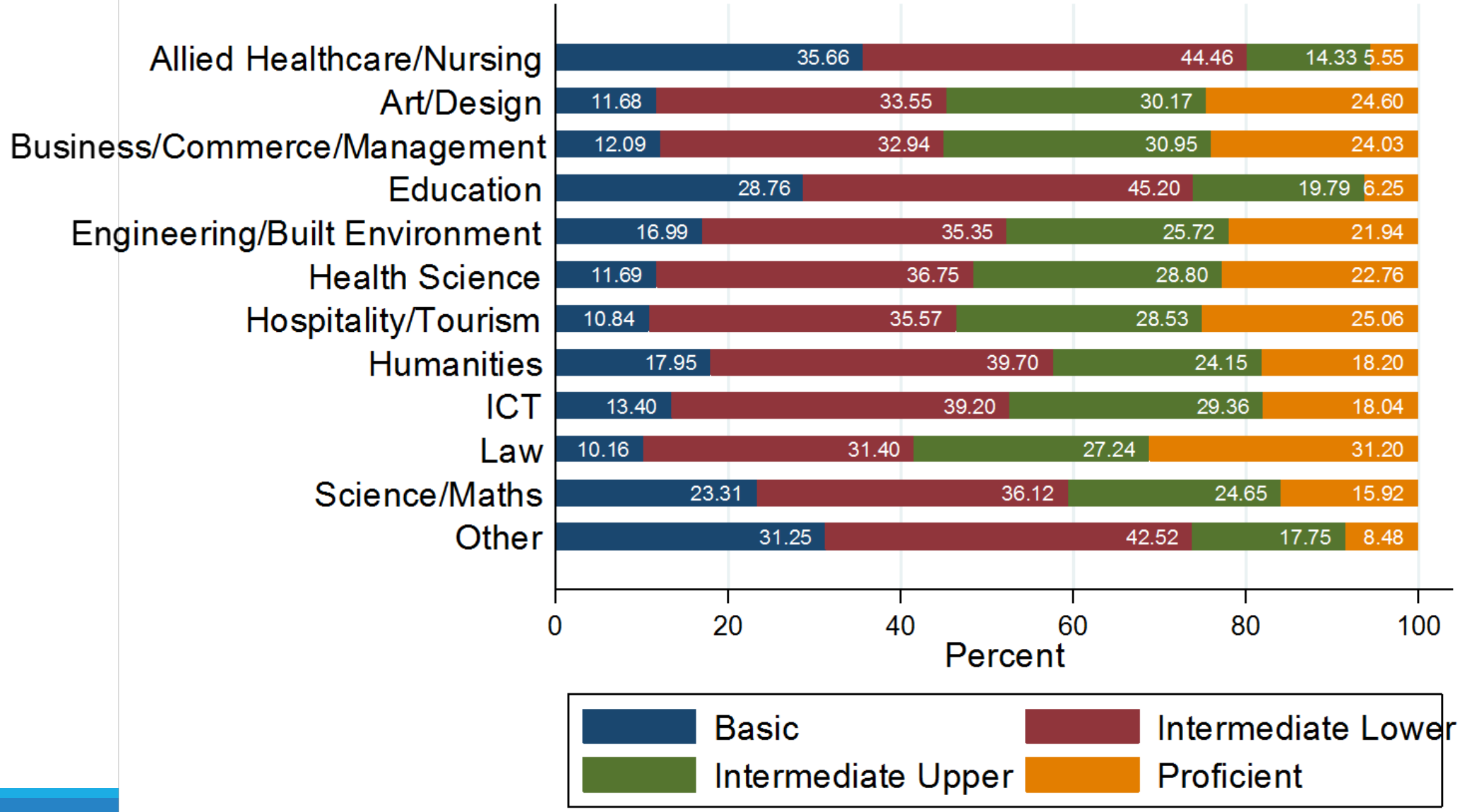
Basic

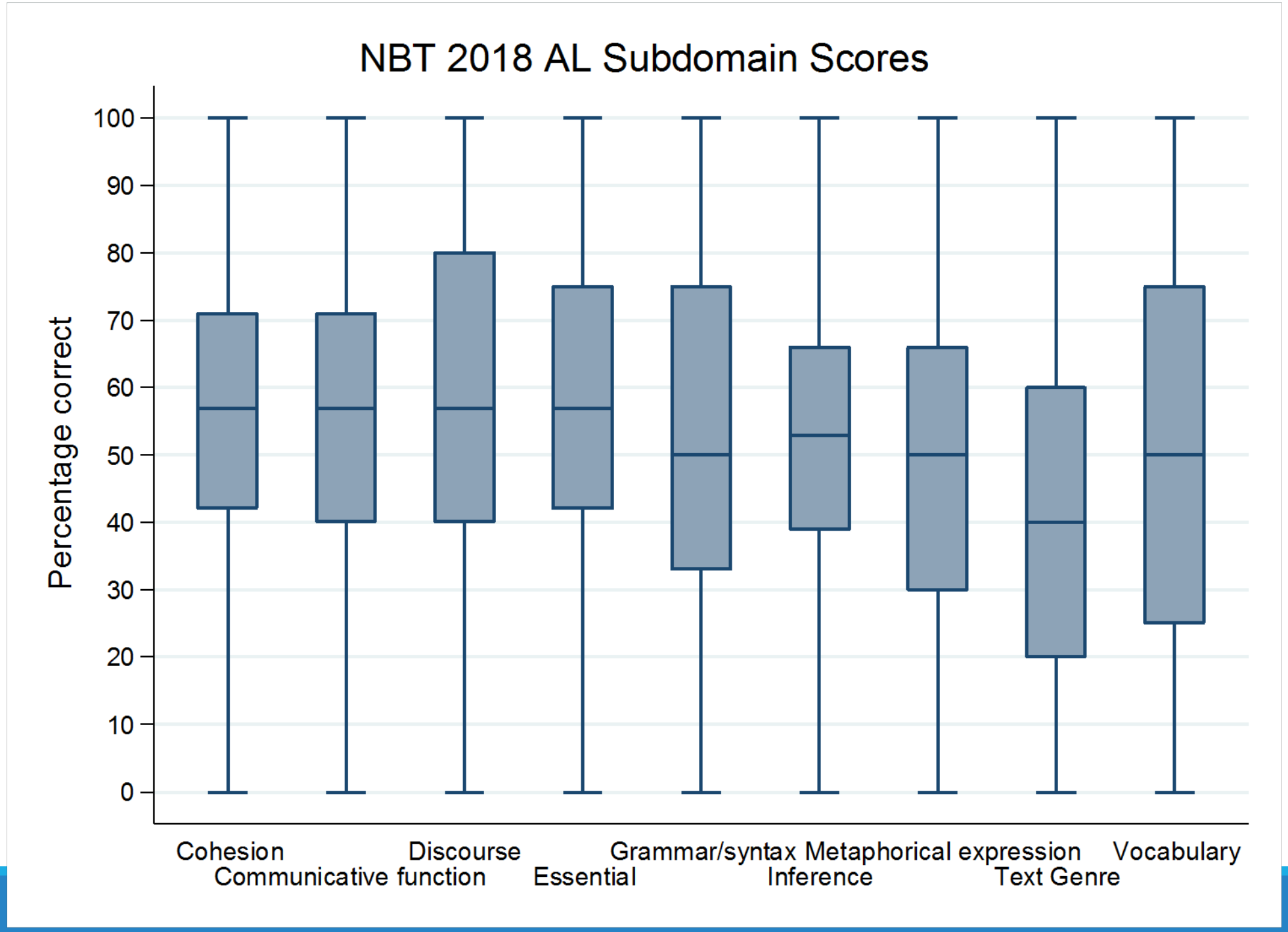
Serious learning challenges identified: it is predicted that students will not cope with degree level study without extensive & long-term support, perhaps best provided through bridging programmes or FET colleges. Institutions registering students performing at this level would need to provide such support.


2018 NBT Cohort Performance Levels
Percentage
0
10
20
30
40
50
60
16.16
36.83
26.65
20.36
44.76
28.92
15.38
10.94
54.17
25.23
11.92
8.69
B
IL
IU
P
AL
QL
MAT
NBT
B = Basic; IL = Intermediate Lower; IU = Intermediate Upper; P = Proficient

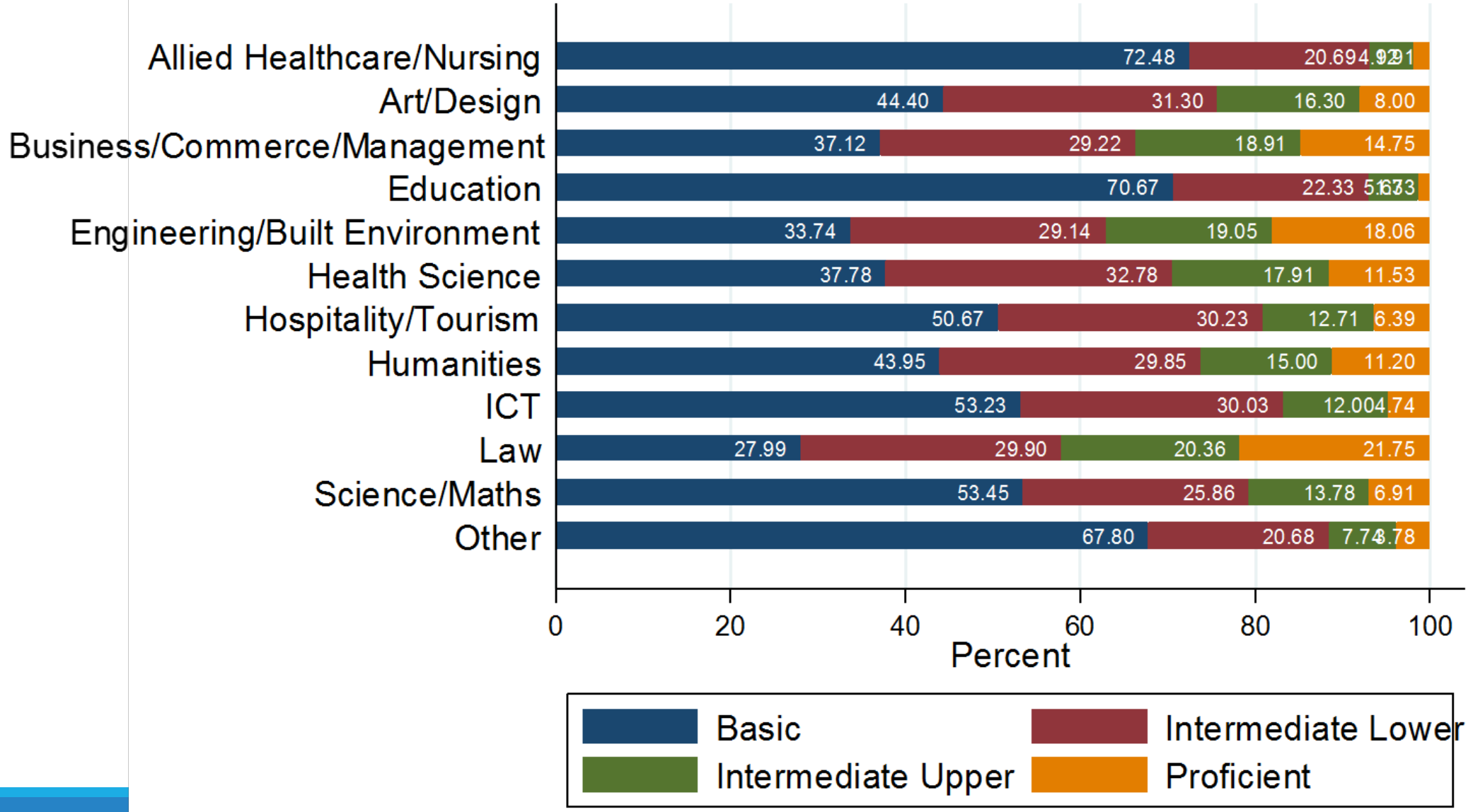

2017 vs 2018 NBT Academic Literacy Performance Levels
Percentage
0
10
20
30
40
15.29
35.31
27.43
21.97
16.16
36.83
26.65
20.36
Basic
Intermediate Lower
Intermediate Upper
Proficient
2017
2018
AL Performance

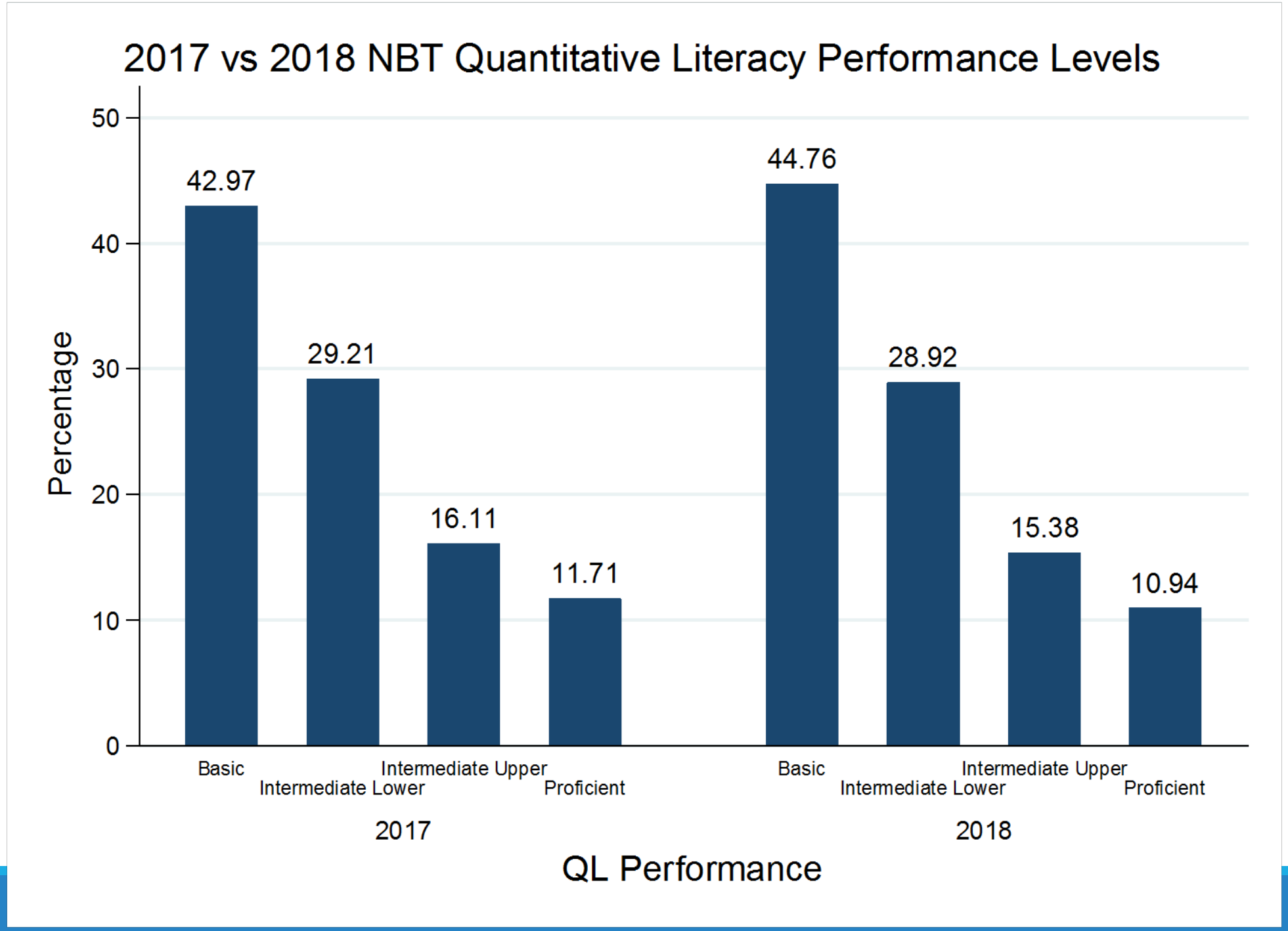
2018 NBT Cohort Academic Literacy Performance Levels by Intended Faculty of Study

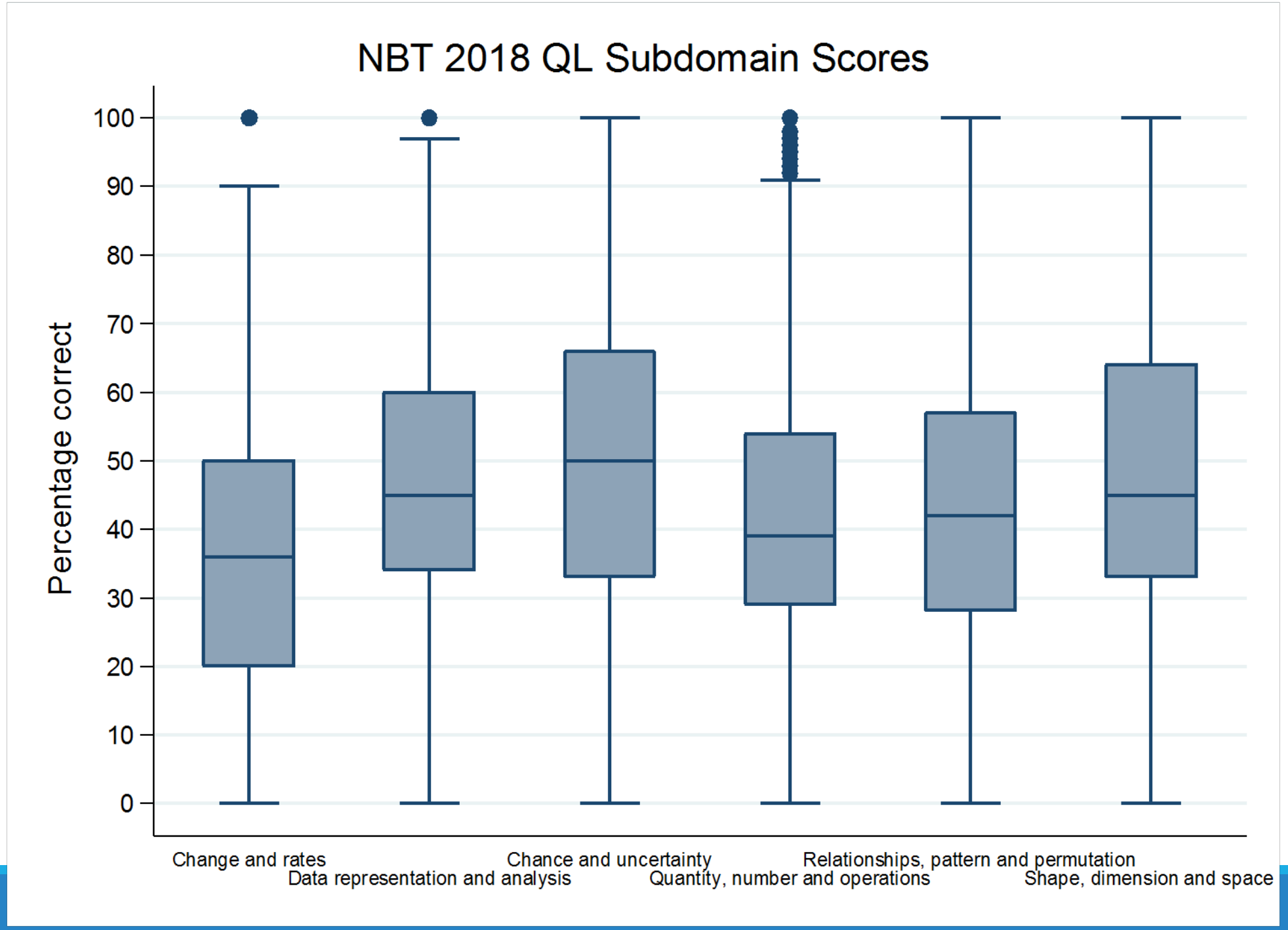



NBT 2018 AL Subdomain Scores
Percentage correct
100
90
80
70
60
50
40
30
20
10
0
Cohesion
Communicative function
Discourse
Essential
Grammar/syntax
Inference
Metaphorical expression
Text Genre
Vocabulary

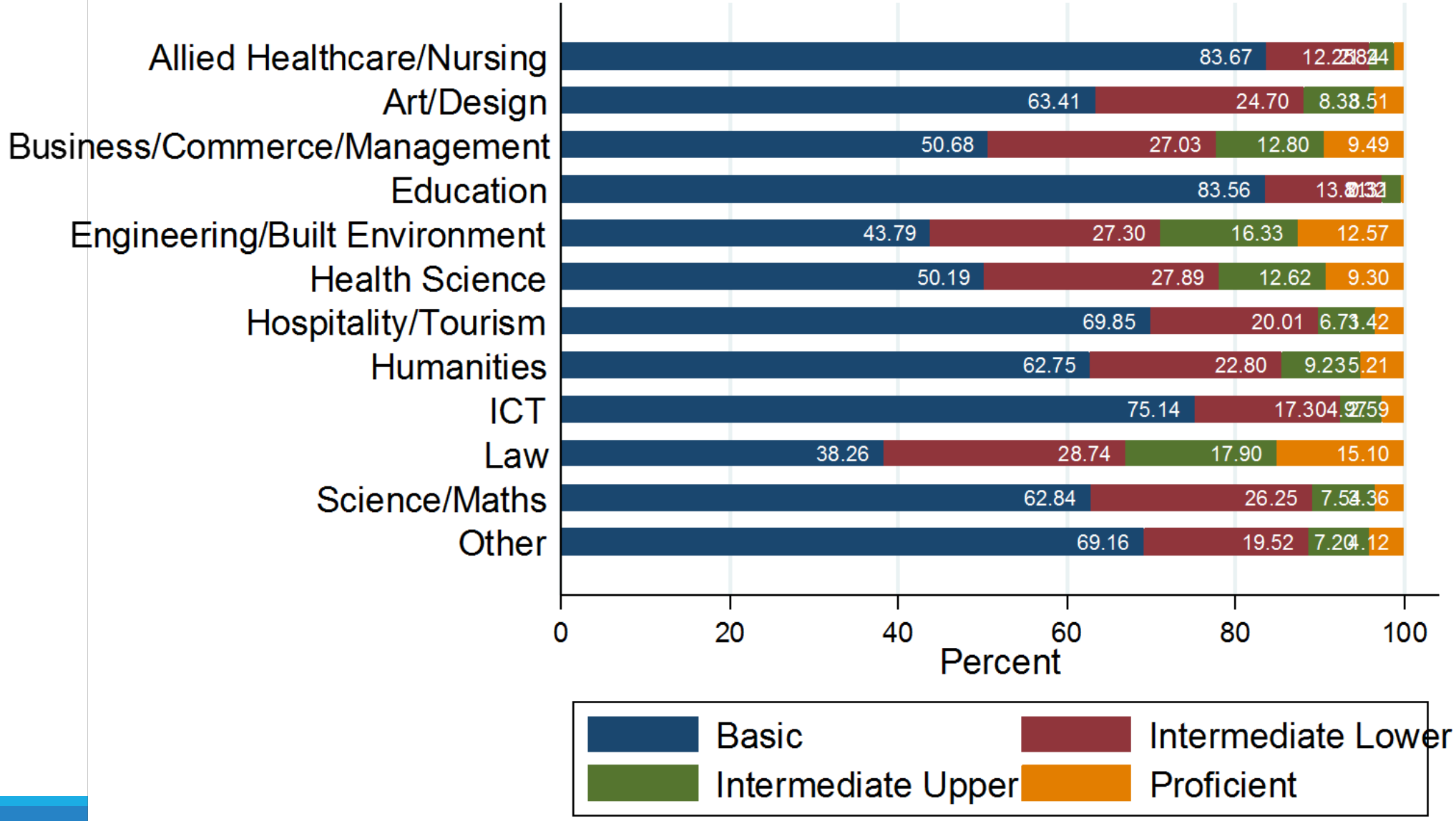
2018 NBT Cohort Quantitative Literacy Performance Levels by Intended Faculty of Study

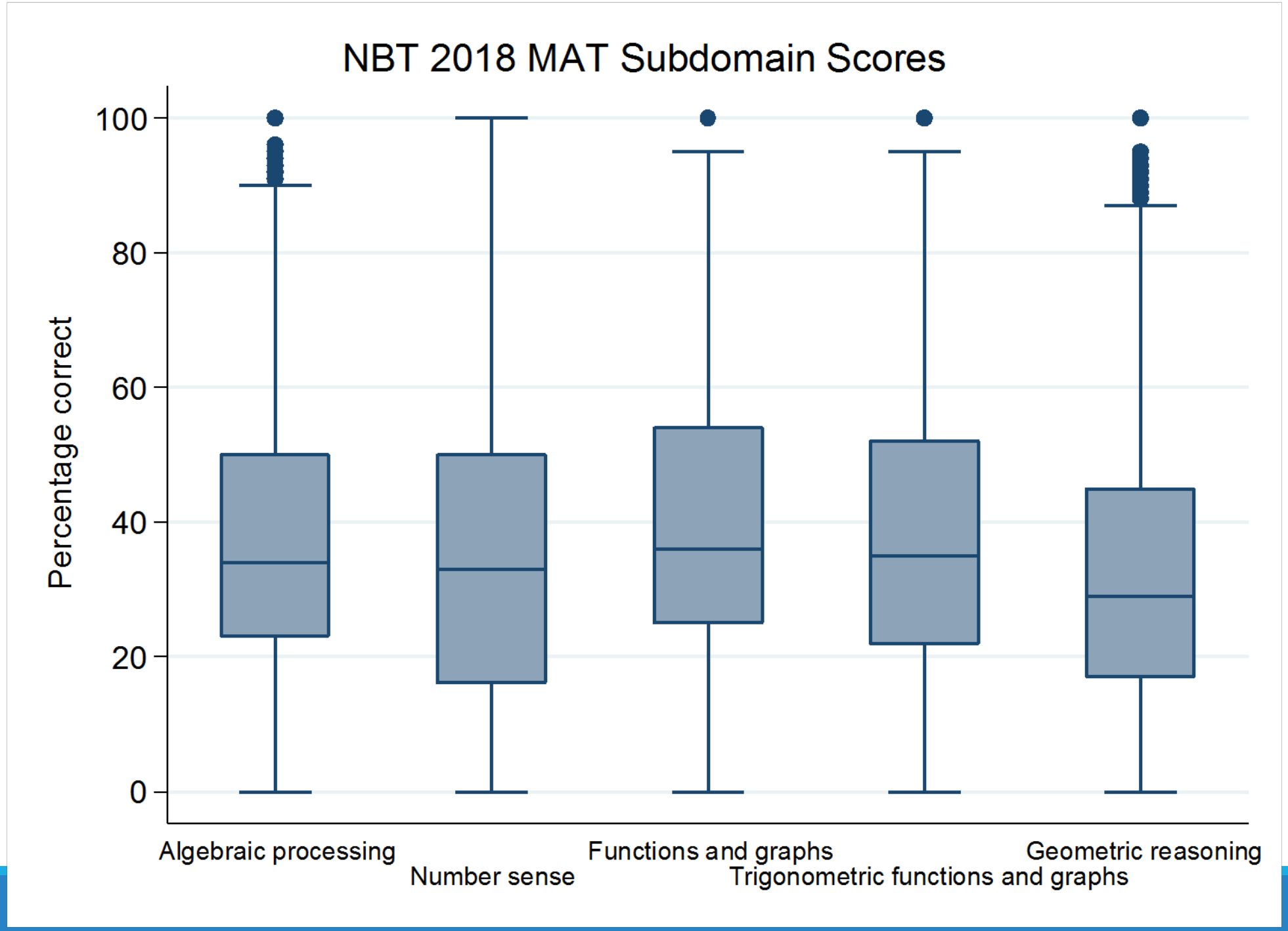


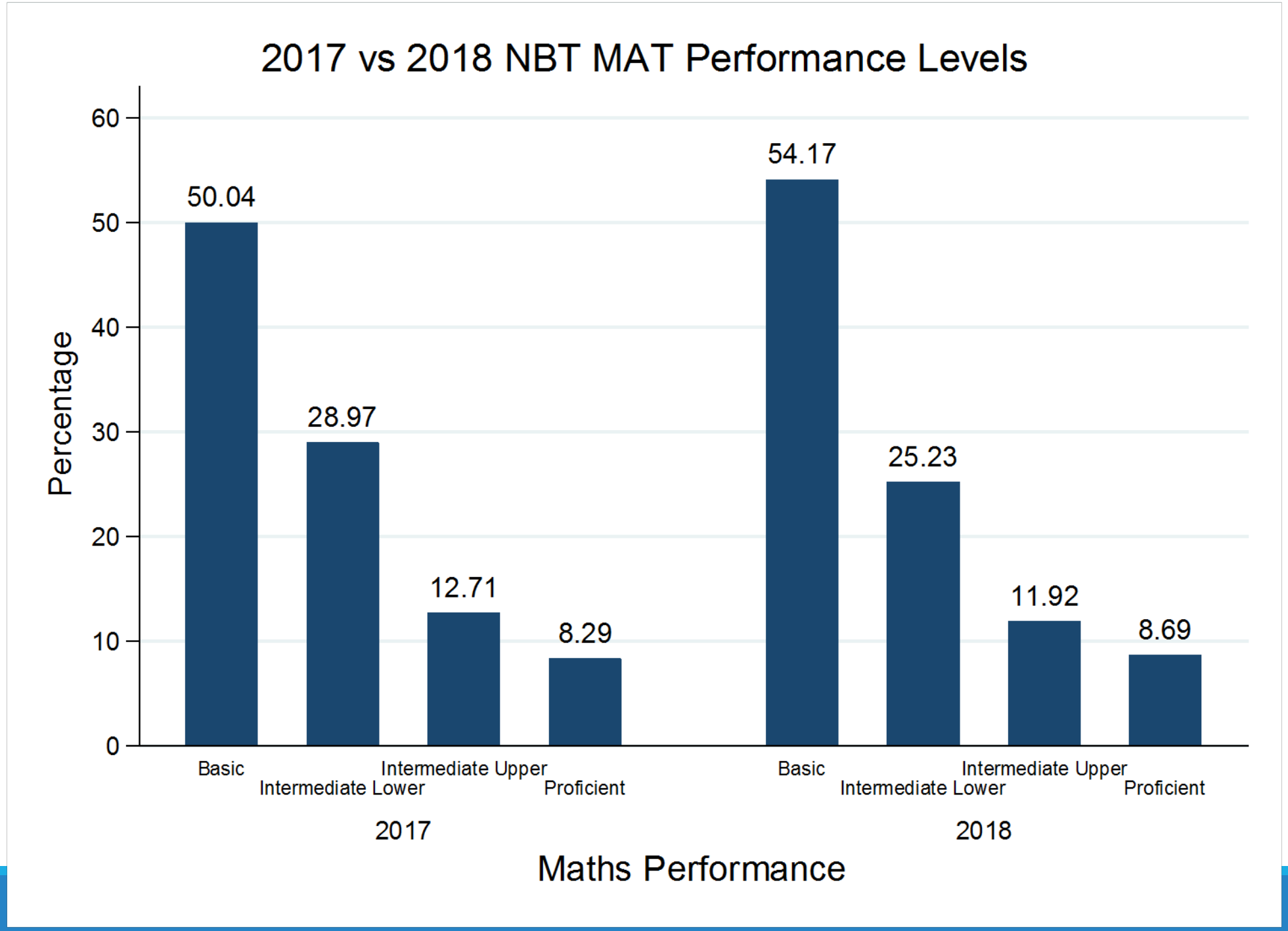

2017 vs 2018 NBT Quantitative Literacy Performance Levels
Percentage
0
10
20
30
40
50
42.97
29.21
16.11
11.71
44.76
28.92
15.38
10.94
Basic
Intermediate Lower
Intermediate Upper
Proficient
Basic
Intermediate Lower
Intermediate Upper
Proficient
2017
2018
QL Performance


NBT 2018 QL Subdomain Scores
Percentage correct
100
90
80
70
60
50
40
30
20
10
0
Change and rates
Data representation and analysis
Chance and uncertainty
Quantity, number and operations
Relationships, pattern and permutation
Shape, dimension and space

2018 NBT Cohort MAT Performance Levels by Intended Faculty of Study




NBT 2018 MAT Subdomain Scores
Percentage correct
100
80
60
40
20
0
Algebraic processing
Number sense
Functions and graphs
Trigonometric functions and graphs
Geometric reasoning


2017 vs 2018 NBT MAT Performance Levels
Percentage
60
50
40
30
20
10
0
50.04
28.97
12.71
8.29
54.17
25.23
11.92
8.69
Basic
Intermediate Lower
Intermediate Upper
Proficient
2017
2018
Maths Performance

Relative importance of NBT subdomain scores

“Relative importance” refers to the quantification of an individual regressor’s contribution to a multiple regression model.(Gromping, 2006).

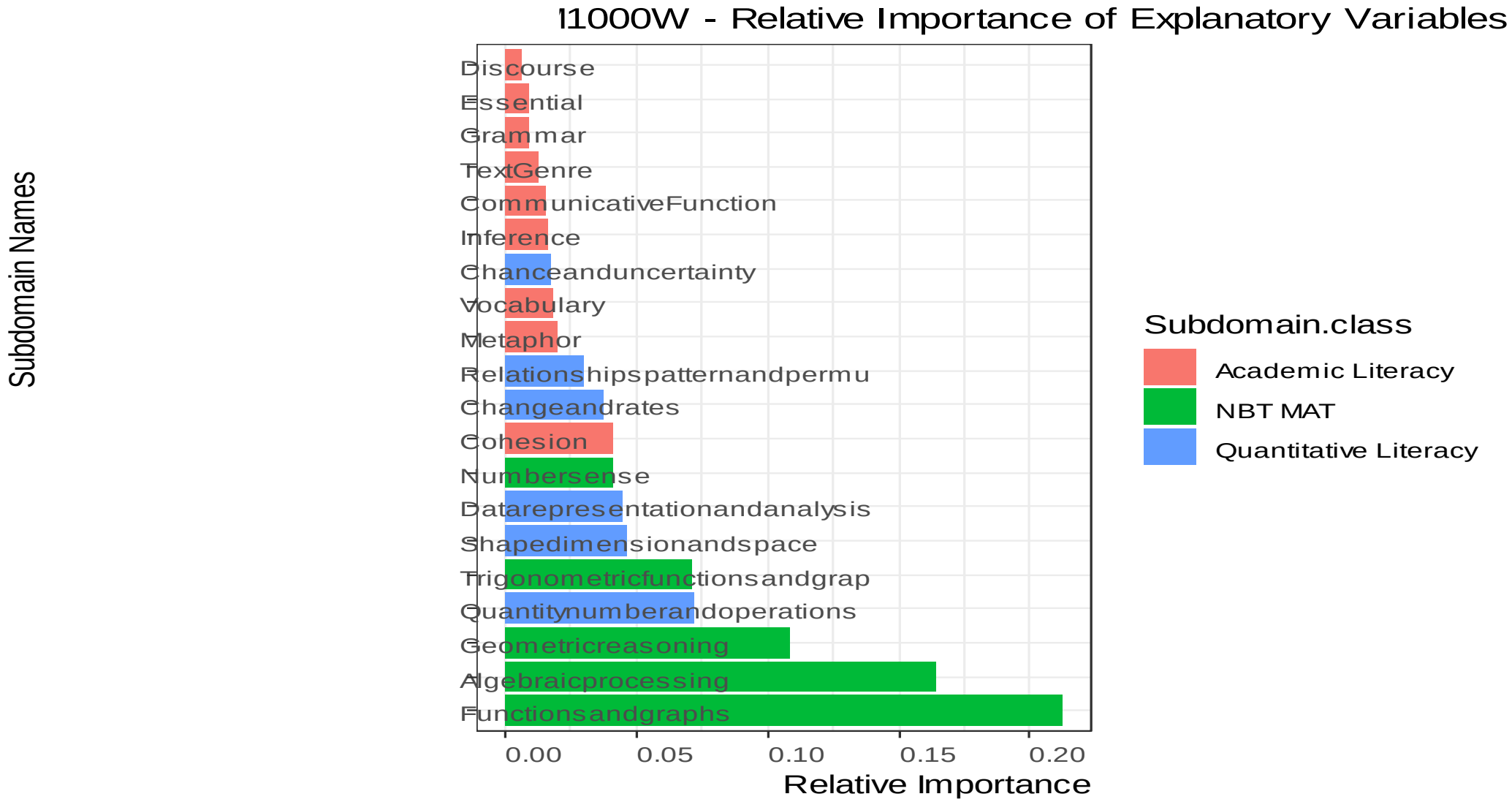
Example: Mathematics 1 at University X

Data: NBT Scores and subdomain scores

- **NBT Maths scores** including subdomain scores (i.e. Algebraic processing, Number sense, Functions and graphs, Trigonometric function and graphs, Geometric reasoning).
- **NBT Academic Literacy** scores including subdomain scores.
- **NBT Quantitative Literacy** including subdomain scores.

Regression model:

- Course Percent ~ AL subdomains + QL Subdomains + MAT Subdomains


11000W - Relative Importance of Explanatory Variables
Subdomain Names
Discourse
Essential
Grammar
TextGenre
CommunicativeFunction
Inference
Chanceanduncertainty
Vocabulary
Metaphor
Relationshipspatternandpermu
Changeandrates
Cohesion
Numbersense
Datarepresentationandanalysis
Shapedimensionandspace
Trigonometricfunctionsandgrap
Quantitynumberandoperations
Geometricreasoning
Algebraicprocessing
Functionsandgraphs
0.00
0.05
0.10
0.15
0.20
Relative Importance
Subdomain.class
Academic Literacy
NBT MAT
Quantitative Literacy

Relative Importance of NBT subdomain scores

Proficiency in '**Functions and Graphs**' is the most important skill required for this course, followed by **Algebraic processing** and **Geometric reasoning**.

Institutions can use these results for the following:

- Identifying the students needing support.
- Identifying the kind of support needed in the course curriculum.
- Develop additional support for students in need.

Implications for Teaching and Learning

1. The NBTs compliment the NSC.
2. The NBTs provide a useful diagnostic element which is not provided by the NSC.
3. The diagnostic information comes through NBT subdomain scores.
4. Subdomain scores show the areas were students need support.
5. Subdomain scores can be used to develop targeted academic interventions for students well before they start their academic journey.
6. Academic practitioners are encouraged to tap into the additional value presented by the NBTs subdomain scores.