

Riding the waves of change in teaching tertiary mathematics

2018



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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Denkleiers • Leading Minds • Dikgopolo Isa Dihlaletsi

Ansie Harding

The secret of change is to focus
all of your energy, not on fighting
the old but on building the new

Socrates

1. Change towards diagnostic testing
2. Change to a new generation
3. Change to micro learning

1. Change towards diagnostic testing

Why a Calculus Readiness Test?

- Concerns on the skills and competencies in mathematics of students entering BSc or Engineering courses.
- Early warning system

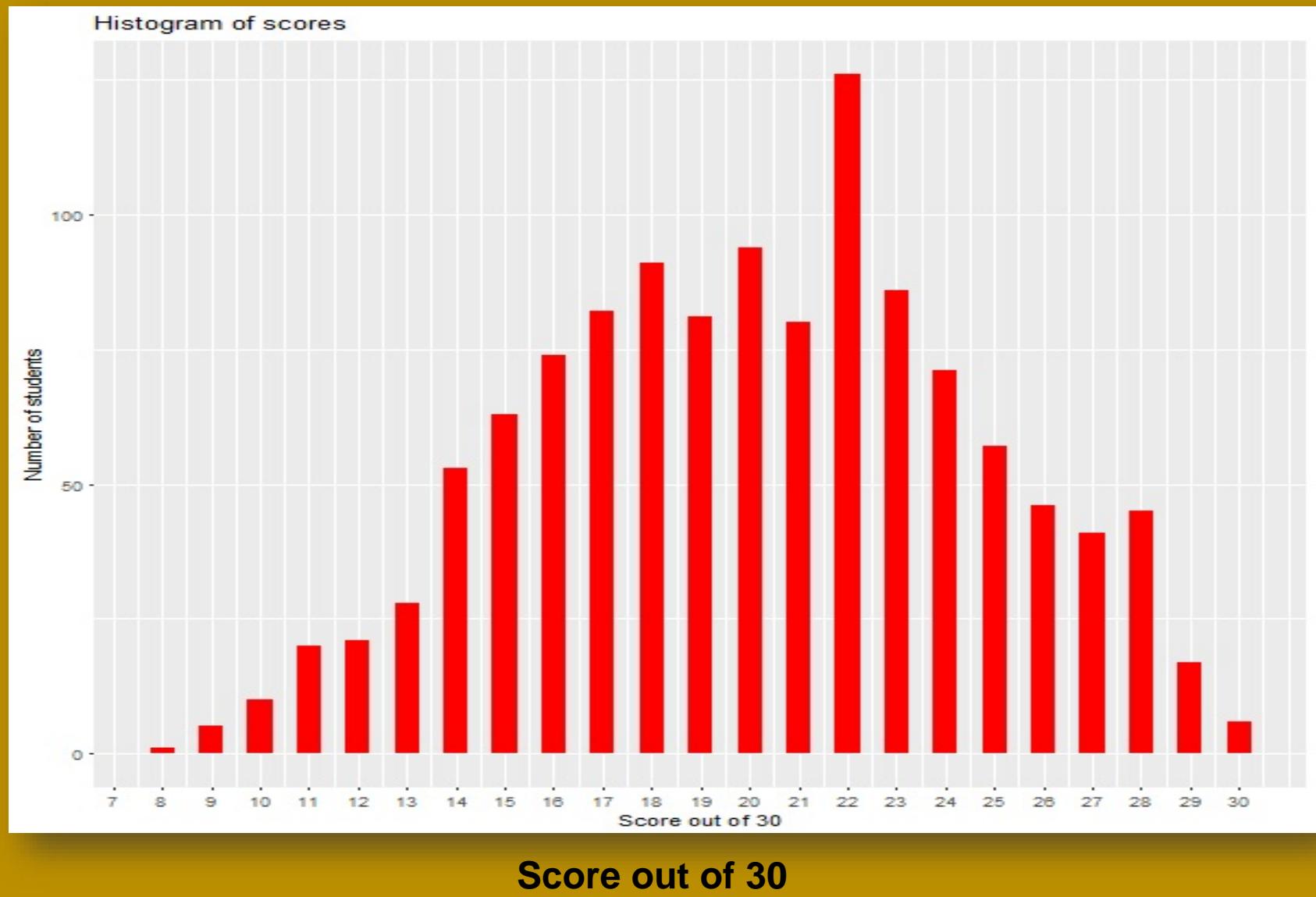
About the CRT test

- 30 MCQ questions (90 minutes)
- Written during the orientation week
- Same test for mainstream and engineering students
- Based on school content (Algebra, Functions, Logarithms and Trigonometry)
- Snapshot of students' current mathematical abilities

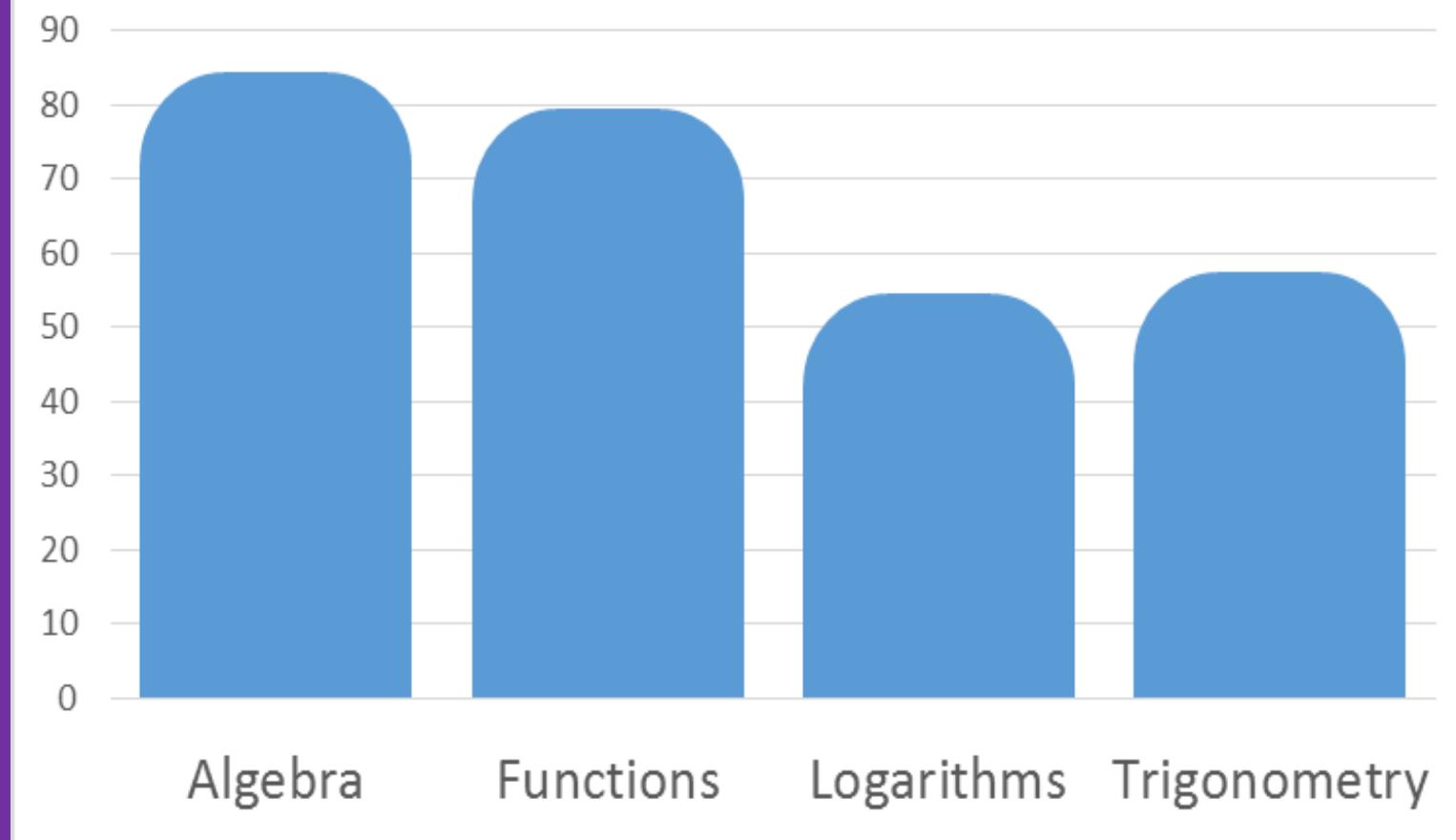
Why not the NBT test?

- Not compulsory
- As with American SAT test - practice tests
- NBT test - written in the previous year - does not test the current knowledge.
- NBT results does not alert students at the start of the year
- NBT test results not available at hand

How did they do?



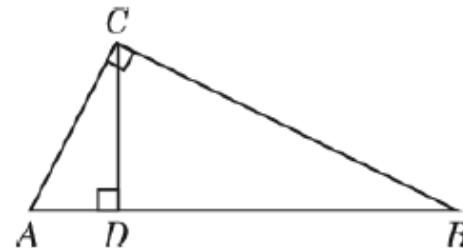
Percentage correct per topic



25% Correct

Difficult questions

30. In right angle ABC shown below, if $AB = 14$ and $BC = 12$, then $BD =$



- (A) 10 (B) $\frac{72}{7}$ (C) $\frac{12}{7}\sqrt{13}$ (D) $2\sqrt{13}$ (E) $2\sqrt{42}$ (F) None of these

28% Correct

27. Suppose $\tan x > 0$. If $\cos x = -\frac{1}{3}$, then $\sin x$ is equal to

- (A) $\frac{\sqrt{8}}{3}$ (B) $-2\frac{\sqrt{2}}{3}$ (C) $\frac{\sqrt{4}}{3}$ (D) $\frac{4}{3}$ (E) $-\frac{2}{3}$ (F) None of these

31% Correct

16. If $\log w = \frac{1}{5} \log x - \log y$, then w is equal to

- (A) $\frac{1}{5}x - y$ (B) $\frac{x^{1/5}}{y}$ (C) $x^{1/5} - y$ (D) $(\frac{x}{y})^{1/5}$ (E) $\frac{x}{5y}$ (F) None of these

Easy questions

90% Correct

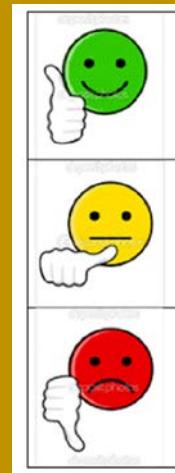
1. If $a = 2$ and $b = -3$, then $\frac{(a-b)^2+b}{(b-2a)^2+a} =$
- (A) $-\frac{2}{3}$ (B) $-\frac{2}{5}$ (C) $-\frac{3}{26}$ (D) $\frac{22}{51}$ (E) $\frac{28}{49}$ (F) None of these

89% Correct

2. $\frac{x^{4b+1}}{x^{2-b}}$ is equal to
- (A) x^{3b-1} (B) x^{2b+2} (C) x^{5b+1} (D) x^{3b+1} (E) x^{5b-1} (F) None of these

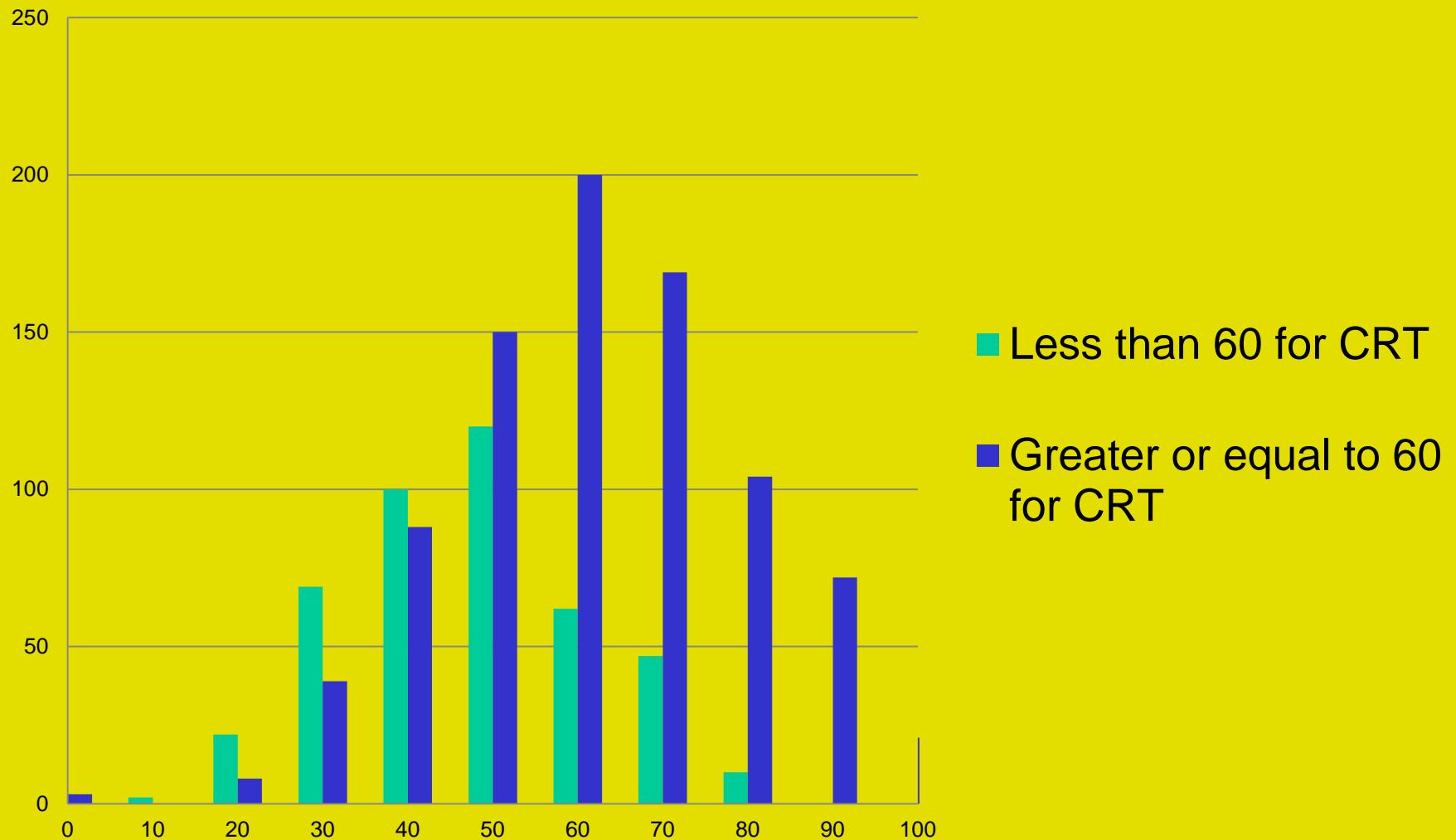
How do we use the results?

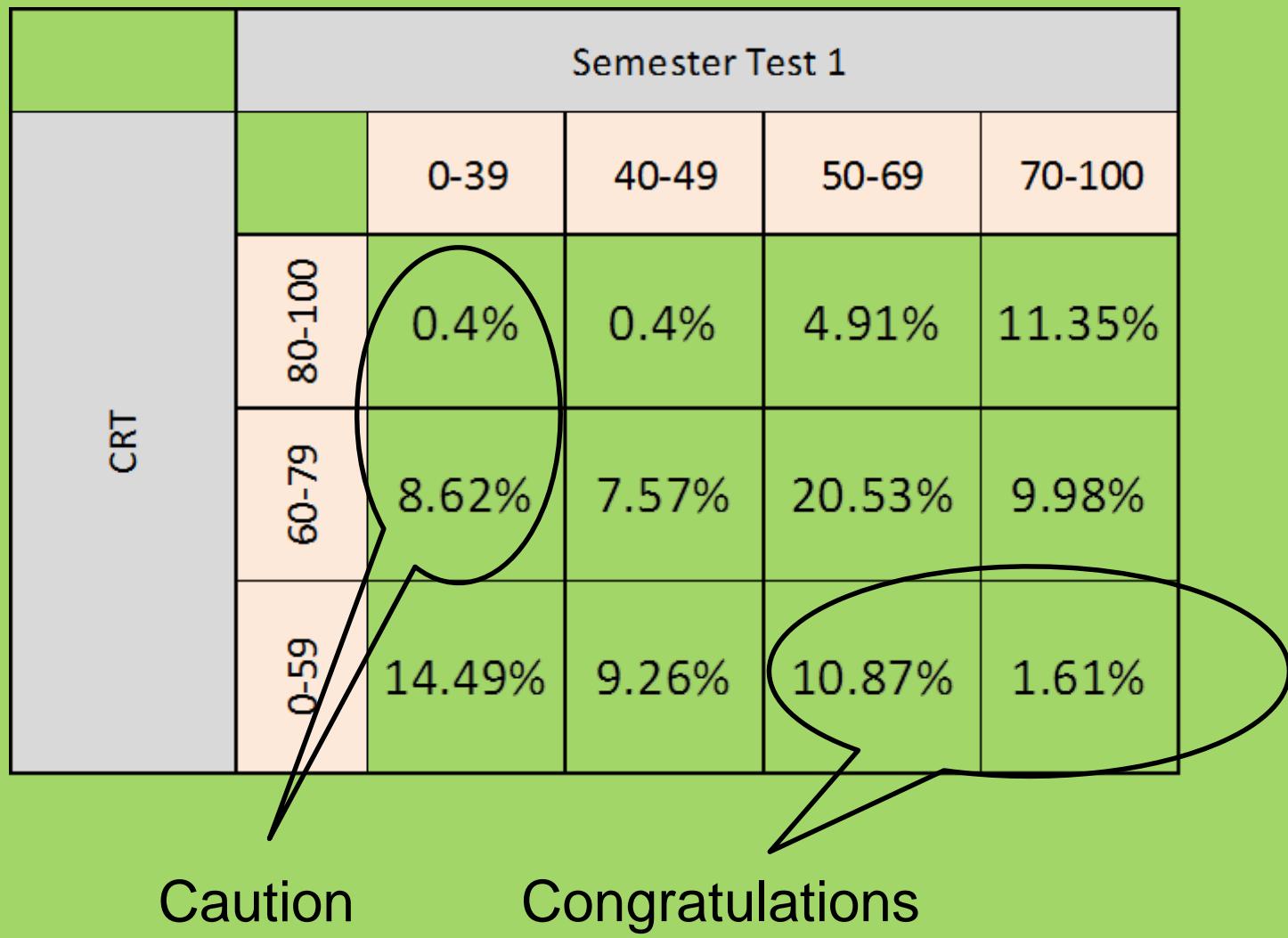
- Students divided into three groups :
Above 80, 60 – 80, less than 60



- Intervention in the last group – practical classes smaller, guidance on study methods, recap work
- “Mam, can I also attend the “dumb group”?”
- Additional Tutor sessions compulsory

Comparing performance in Readiness Test and Average of Semester Tests 1 & 2





	Semester Test 1				
CRT		0-39	40-49	50-69	70-100
	80-100	0.4%	0.4%	4.91%	11.35%
	60-79	8.62%	7.57%	20.53%	9.98%
	0-59	14.49%	9.26%	10.87%	1.61%

2018					
	Final Exam Marks_WTW158				
CRT%	987/988	0-39	40-49	50-69	70-100
80-100	0.6%	0.2%	0.3%	4.9%	11.8%
60-79	2.7%	3.1%	5.7%	25.3%	11.7%
0-59	5.6%	4.9%	7.4%	18.6%	2.9%

Success? Individuals rather

“Good Day Prof Harding. I am in your practical class. I obtained a very poor mark for the first semester test (45% to be exact). This came as a big shock to me but I did not give up. I started using your lecture notes, which made a huge difference for me. I had 80% for the second semester test and I just wanted to say thank you that you kept us positive and encouraged us to do better and for all the advice. It helped me a lot to pick up speed and made mathematics very enjoyable to me.”

Revamping the practical sessions

- Sign-up sheets
- Worksheets
- Activity at the end of the session –
Tut test or ClickUP test
- Password protected ClickUP test
- Password provided at the end of the session

2. Change to a new generation

- **Silent Generation (born 1925 – 1945, of age in 1943, 73 – 90 yrs old)**
Children should be seen, not heard. Traditionalists, grew up in lean times, work is a privilege, respect authority
- **Baby Boomers (born 1946 – 1964, of age in 1964, 54 – 72 yrs old)**
Workaholics, go for promotions & raises, more educated, anti-war
- **Generation X (born 1965 – 1980, of age in 1983, 38 – 53 yrs old)**
Double income families, balanced work & family life, divorce, more female grads, digital immigrants, **computer** at home

- **Millenials (born 1981 – 1994, of age in 2000, 24 – 37 years old)**
Internet, emails and cell phones, laptop, globally minded, digital natives, multitasking, majority female grads, remembers dial-up connection
- **iGen or Gen Z (born 1995 – 2009, of age in 2013, 9 – 23 years old)**
Tablets, smart phone, life with social media, apps, cloud natives, short attention span, help yourself, used to terrorism, global warming, selfies
- **Gen Alpha (born 2010 - 2025, of age in 2028, 8 years and older)**
Children of millennials, in school now, most diverse generation, screen in hand before they could talk, as old as the iPad, iPad as babysitter

A photograph showing five young adults lying on a light-colored wooden floor, viewed from directly above. They are all looking down at electronic devices: one man on the left holds a smartphone, another man in the center has a laptop open, a woman in the middle-right holds a smartphone, and two men on the right hold tablets. They are dressed casually in jeans, t-shirts, and sneakers.

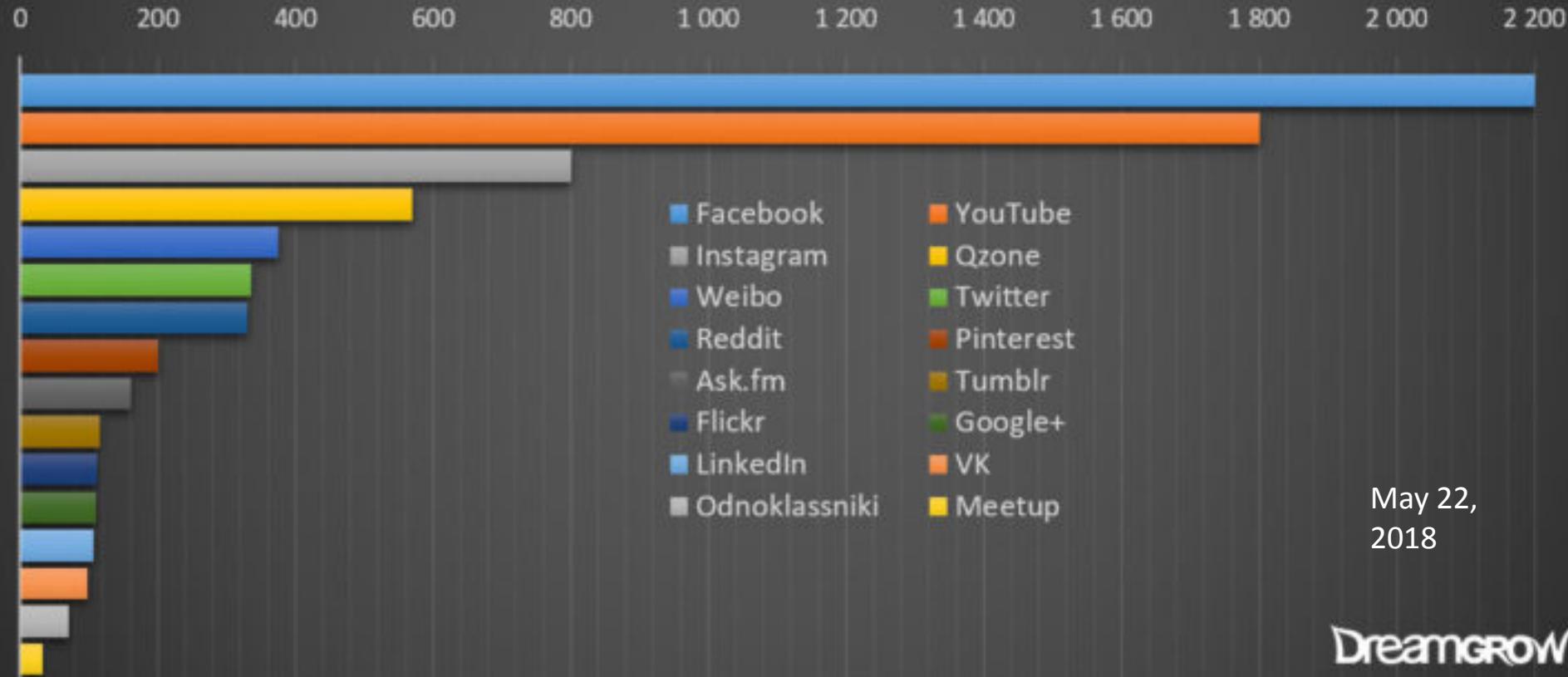
GENERATION Z

The social media generation

Our students

Top 15 Most Popular Social Networking Sites

MILLIONS



born after 1996, reaching universities now
connected 24-7 to a borderless world
communication is brief using icons, emojis, new syntax
instant gratification
Google it
watches videos rather than movies
checks phone every few minutes

a sense of entitlement
short attention span
prefer to construct rather be instructed
headed toward careers that do not yet exist
entrepreneurial
self help from the internet

Together, this generation learns collectively through YouTube channels, live streaming, content curation, and social influence. To a Gen Z learner, there is not one source of knowledge called an 'expert'... the expertise lies in the collective knowledge.

Then



Now



- Snapchat sunglasses
- Wireless earphones
- Apple watch
- Phone
- Sapscan debit card
- Ipad as a notebook
- Laptop
- Smart light bulbs
- Alexa for info
- One-hour online delivery
- Twitter presence, hardly any Facebook presence

What do THEY say?

Where do you go to for help?

2012

- Friends 75%
- Internet (YouTube etc) 71%
- Lecturer 25%



2017 (Ranking)

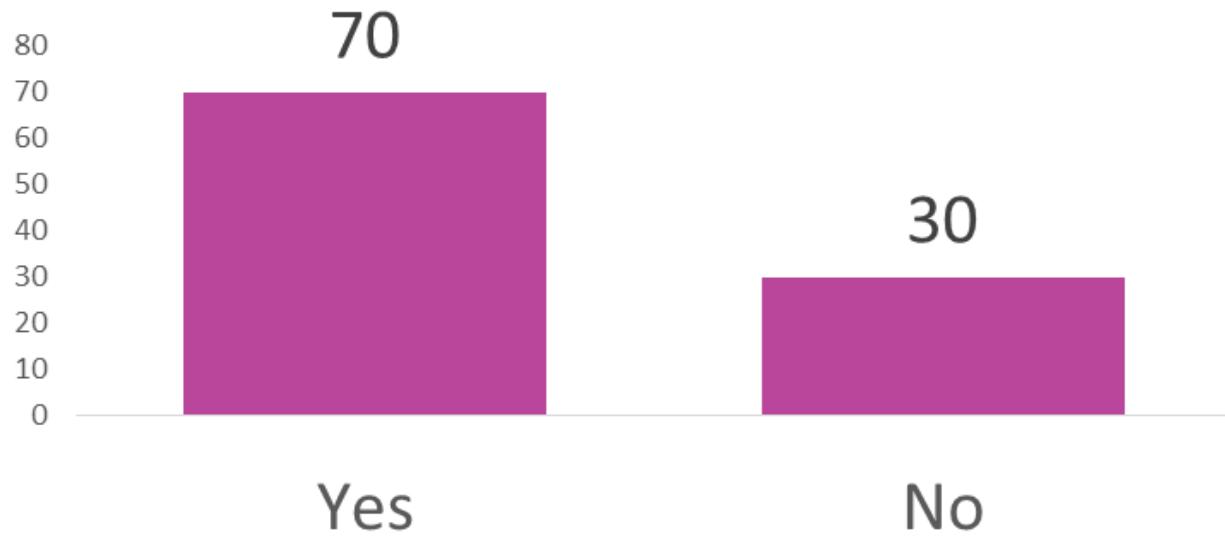
1. Own & posted notes
2. Friends
3. YouTube
4. Textbook
5. Lecturer
6. Tutor

2018 (Ranking)

1. Own & posted notes
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**Could you live without
Social Media?**

Could you live without social media?



Does social media get in the
way of your studies?

Does Social Media get in te way of your studies?

59%



18%

8%

15%

No

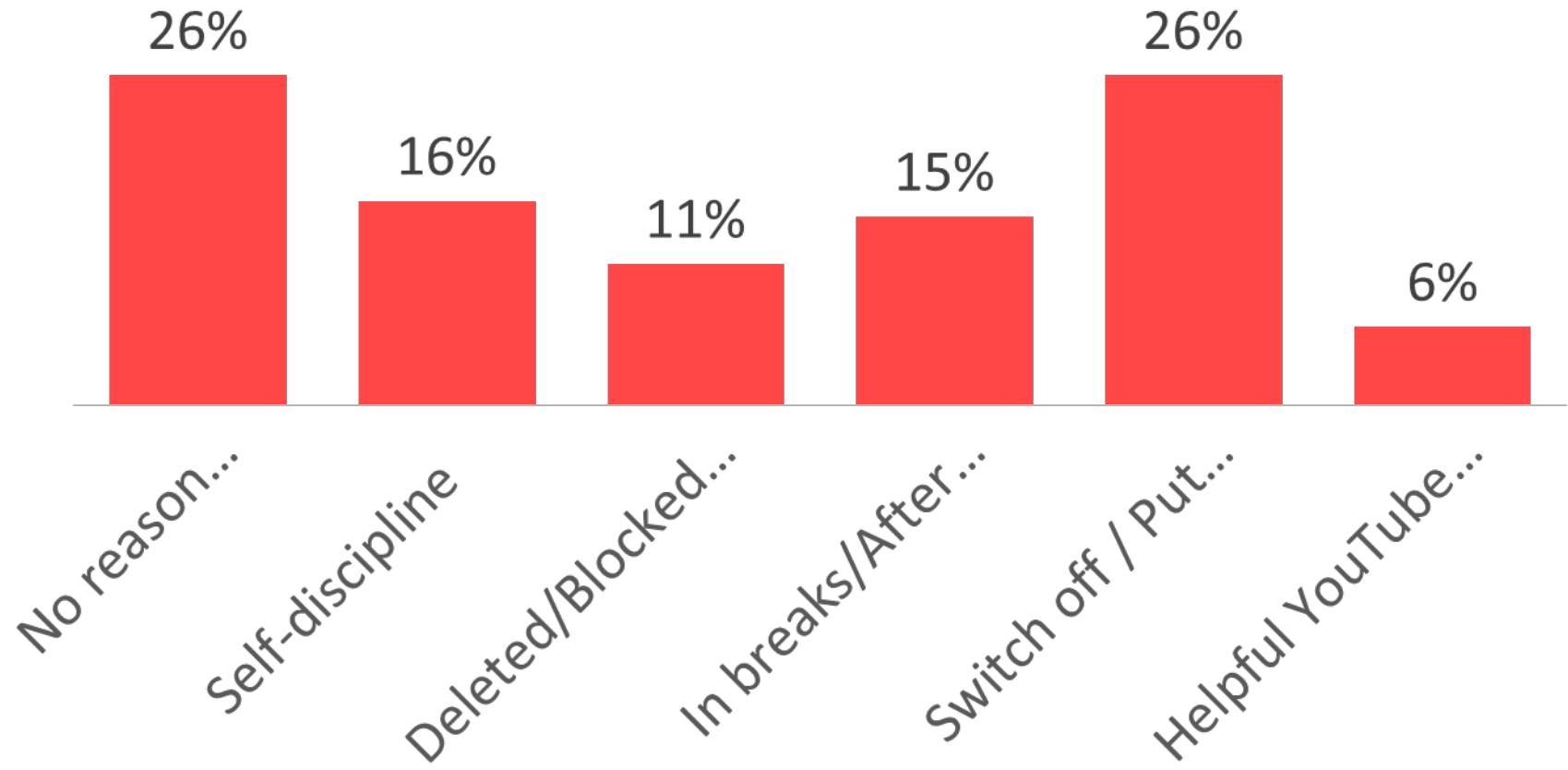
Yes, but
coping

Sometimes

Yes

No? Why not?

No? Why not?



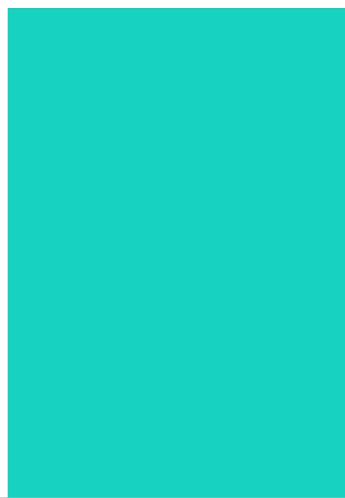
**How many hours per day do
you spend on Social Media?**

Hours per day on Social Media

35%

34%

31%



0 - 1 hr

1 - 2 hr

> 2 hr

Let's pause for
perspective

In 2016 there were 1.59 billion
TV households in the world

What do WE observe?

**Technologically savvy and
well-equipped**

Knowledgeable about
many things

Reading and writing skills
questionable

Abanno - Chabala	Large Chemistry Hall
Chacha - Fitzsimons	Te Water Hall
Fleming - Jordan	Centenary 5
Josiah - Macakati	Centenary 3
Machava - Mazibuko	Thuto 3-1
Mbalati - Mthembu	Thuto 1-1
Mthiyane - Novello	Thuto 1-2
Novuka - Roos	Eng III - 1
Rossi - Vilar	Eng III -2
Vermeulen - Zuma	Eng III - 6

Question 4 / Vraag 4 [2, 2, 1, 2]

Consider the function $f(x) = x^x$, which is defined for $x > 0$. The derivative of the function is given by $f'(x) = x^x(\ln x + 1)$.

Beskou die funksie $f(x) = x^x$, wat gedefinieer is vir $x > 0$. Die afgeleide van die funksie word gegee deur $f'(x) = x^x(\ln x + 1)$.

4.1 Determine / Bepaal $\lim_{x \rightarrow 0^+} x^x$.

$$\begin{aligned} &\lim_{x \rightarrow 0^+} x^x \\ &= \lim_{x \rightarrow 0^+} x^x (\ln x + 1) \end{aligned}$$

Wat moet ek hier merk? (0°)

$$(0^\circ)(\ln(0) + 1)$$

$$(0^\circ)(-\infty)$$

$$\begin{aligned} &\lim_{x \rightarrow 0^+} x^x (\ln x + 1) \\ &= \lim_{x \rightarrow 0^+} x^x \cdot \ln x + \lim_{x \rightarrow 0^+} x^x \cdot 1 \\ &= \lim_{x \rightarrow 0^+} x^x \cdot \ln x + \lim_{x \rightarrow 0^+} x^x \end{aligned}$$

4.2 Determine the intervals on which the function is increasing / decreasing.
Bepaal die intervalle waarop die funksie stygend / dalend is.

$$\begin{aligned} f'(x) > 0 &= \text{stygend} & f'(x) < 0 &= \text{dalend} \\ x^x(\ln x + 1) > 0 & & -1 < \frac{\ln x + 1}{x^x} & \\ x^x(\ln x + 1) > 0 & & \frac{\ln x + 1}{x^x} < 0 & \\ x^x > 0 & & \ln x + 1 < 0 & \\ x > 0 & & x > e^{-1} & \\ x > 0 & & x > \frac{1}{e} & \end{aligned}$$

4.3 Use the First Derivative test to determine the local extreme(s) of f .
Gebruik die Eerste Afgeleide toets om die lokale ekstreem(e) van f te bepaal.

$$\begin{aligned} x^x(\ln x + 1) &= 0 \\ x^x e^{\ln x + 1} &= 0 \\ x^x &= 0 \\ x &= e^{0/x} \\ &\uparrow \text{lokale minimum} \end{aligned}$$

$$x \in \left(0, \frac{1}{e}\right)$$

stygend

$$x \in \left(\frac{1}{e}, \infty\right)$$

dalend

Ignore rather than face
academic problems

Some incredibly smart
students

Parent involvement

**What are the skills
required for NOW?**

Life skills more so than
‘seen to be clever’

Self-discipline
Independence
Seeking help in time





“It is futile to demonize social media – it is going to be the future we live in and our careers will be defined by our online presence and social media usage. It is better to learn to leverage social media for good and to improve your life / personal connections. Social Media is powerful and keeps humans aware of each other’s lives – university camaraderie online basically.”

Anonymous student 2018

3. Change to micro learning

Social learning

Social learning is based on the premise that people learn from one another via observation, imitation and modelling.



Relationships

... the undergraduates who are ... most successful ... have at least one (and often more) intense relationship built around academic work with other people. Some have it with a professor, some with an adviser, and others build it around a group of fellow students outside the classroom.

And almost without exception, students who feel they have not yet found themselves, or fully hit their stride, report that they have not developed such relationships.



*Richard J Light,
Harvard Graduate
School of Education.*

Personal Learning Networks (PLNs)

PLNs consist of **the people involved** with the use of tools only implied – an informal network of people a learner interacts with and derives knowledge from.

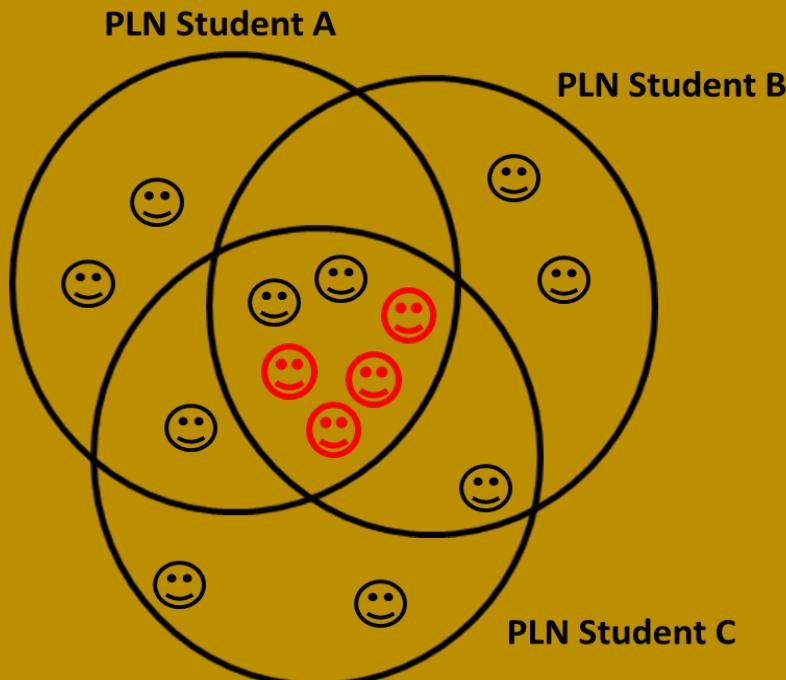
The **longevity** of PLNs is one of the most important features. Time-based, course-centric communities die. PLNs cultivate sustained, long-term learning.



Personal Learning Network Cluster

A small group of people who regularly interact and whose PLNs have a non-empty intersection that includes all the other members.

A PLN cluster is a subset of the intersection of the PLNs of its members.



Cluster formation

- Form at the onset of the first year of studies due to being friends before or meeting in class; 3 - 5 members
- Clusters undergo change but not dramatically so, stability is noticeable
- 57% in clusters, 43% not (second years)



Activities

- Communication via social media
- Face to face activities are scheduled at fixed times or on a needs basis; in library, at each other's homes or even in the cafeteria.
- Do assignments and projects in their clusters
- When someone in the group struggles an emergency call is sent out. If no-one can solve the problem a member is delegated to see the lecturer.
- All activities are self-generated (a knowledge pull community).

The hybrid dilemma

Benefits

- A 24/7 helpline available
 - “Using collective knowledge to achieve our goals”
 - “We fill each other’s blanks.”
- Enhanced social skills, better communication skills, learning to be patient
- Motivation, support from caring friends, a sense of belonging
 - “Knowing that I am not alone in my struggle”
- Speaking your mind without fear of sounding like a fool; multiple points of view. “Bad ideas get weeded out quickly” with no hard feelings
- Practical benefits such as access to class notes, info on dates, explanations from cluster members



Social Learning Spaces

- Spaces on campus where students informally spend academic time together, or alone.
- UP is rapidly identifying and developing such spaces.
- Makerspace – a social learning space with a difference



It is not necessary to change
Survival is not mandatory

Deming

Thank you