



Transforming quantitative skills development and student success using OERs

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CARNEGIE MATH
PATHWAYS
WestEd

VISION **130**
*Renew and Reimagine
for 2034*

UNIVERSITY OF THE
FREE STATE
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FREISTATA



UFS
ECONOMIC AND
MANAGEMENT SCIENCES

Acknowledgements

WestEd

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UFS

- Francois Strydom
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- Sivuyile Nzimeni

“

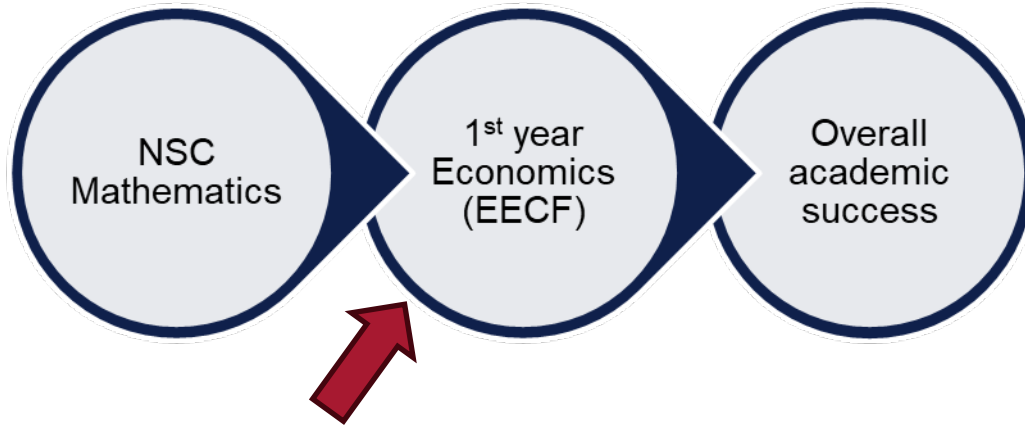
Teamwork is the
secret that makes
common people
achieve uncommon
results

- Ifeanyi Enoch Onuoha -

Why quantitative skills development?

In 2013 the Faculty of Economic & Management Sciences had:

- The lowest graduation rate at the UFS, even though NSC Mathematics is a prerequisite for admission to any programme in the faculty.
- Data analysis showed that:



Addressing the need to understand and improve predictability student overall success

Alternatives to the traditional algebraic sequence

- Mathematics could be contextualized and relevant and engaging to students
- A mathematics classroom could be a place where students develop a sense of belonging and grow their confidence in themselves as learners & where instructors are equipped to support the whole learner



Statway & Quantway

Source: WestEd, 23 April 2024

Alternatives to the traditional algebraic sequence

- Not all students need to be on the path to calculus
- Students could learn the concepts of college level statistics and quantitative reasoning **WHILE** building their algebraic understanding and skills



Statway & Quantway

Source: WestEd, 23 April 2024



Productive Persistence: Students continue to put forth effort during challenges and when they do so they use effective strategies

Academic Mindsets

Students believe they are capable of learning.

Social Belonging

Students feel socially tied to peers, faculty, and the course.

Value

Students believe the course has value.

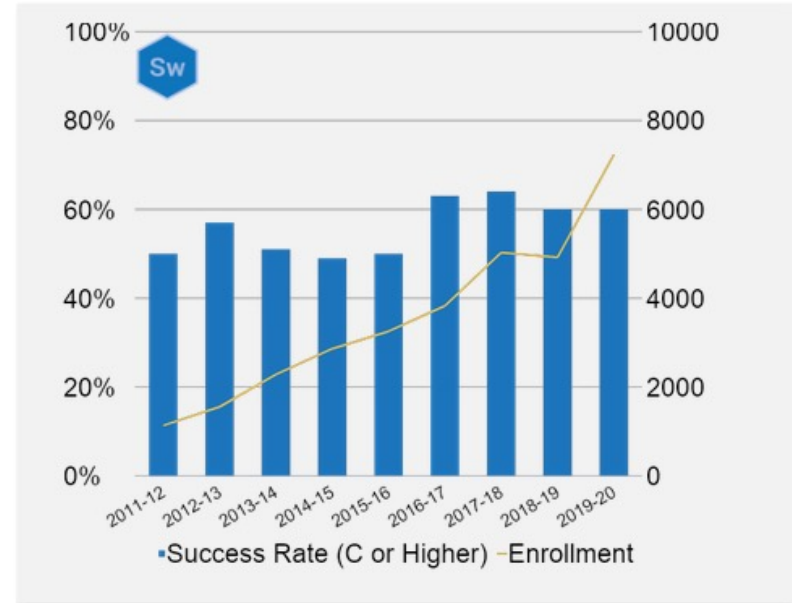
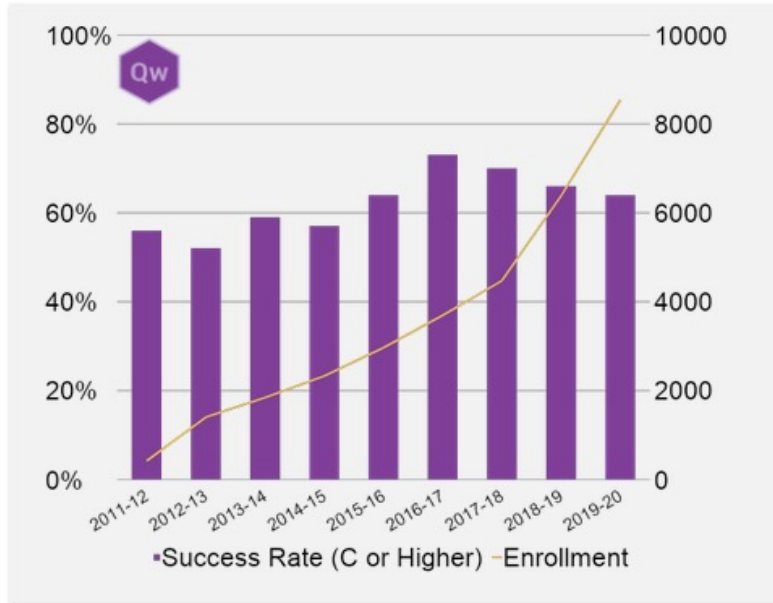
Skills & Know-how

Students have skills, habits and know-how to succeed in college setting.

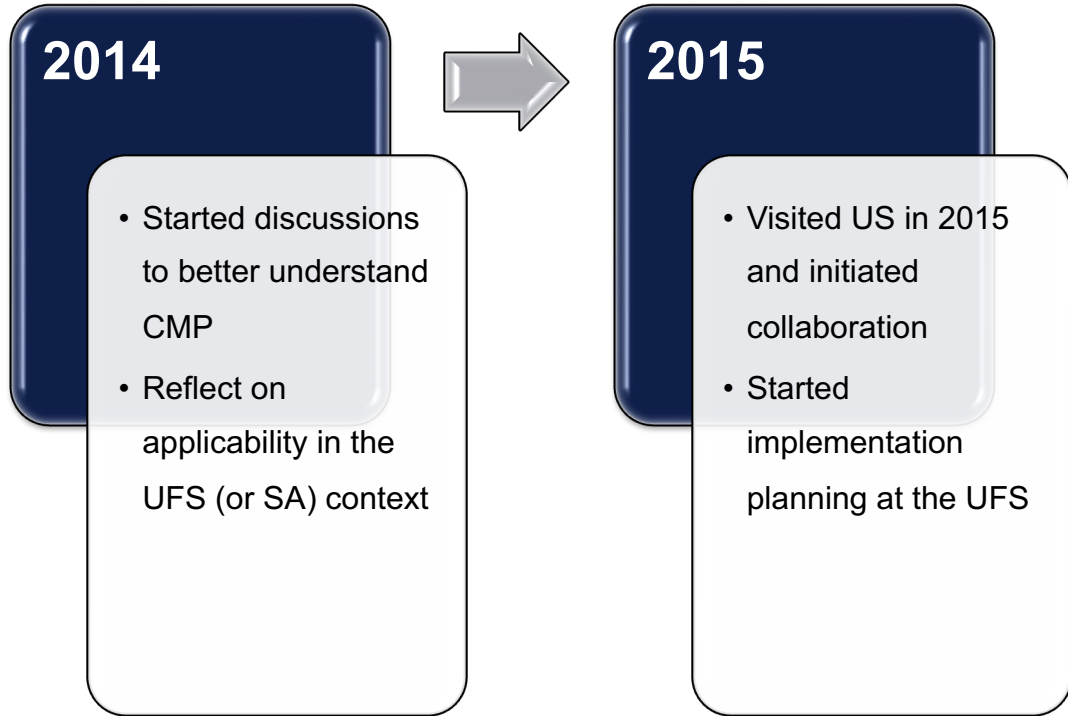
Support

Faculty and college support students' skills and mindsets.

Triple the Success in Half the Time (2011-2020)

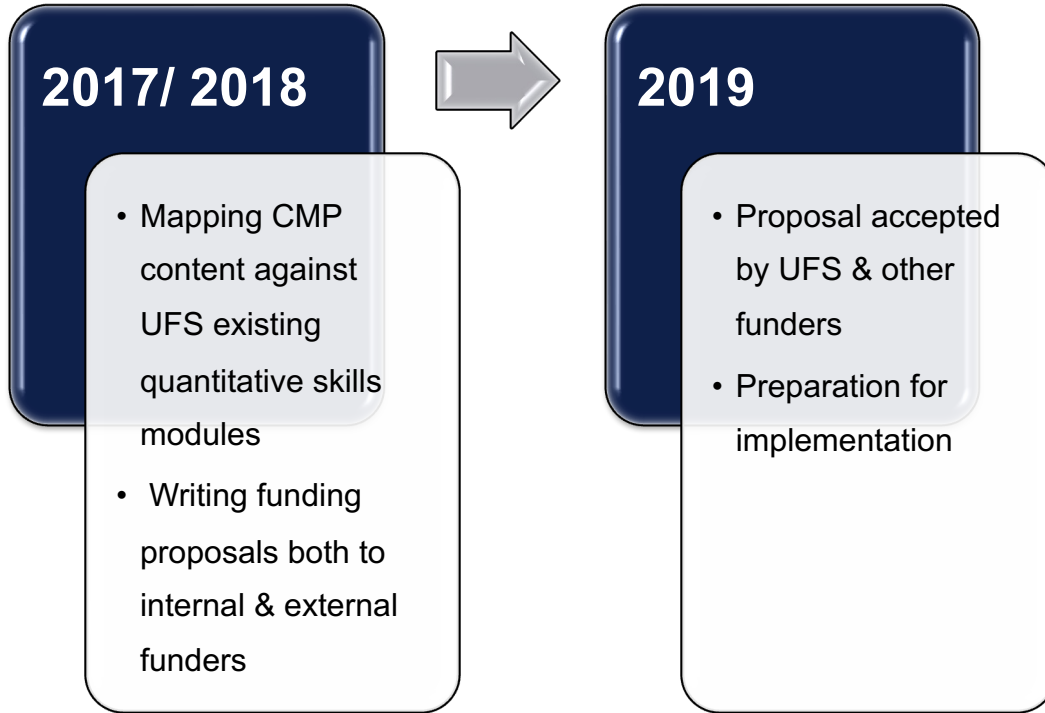


The UFS process

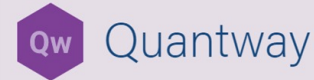


- ✓ Alternative pedagogy and innovation (incl. productive persistence)
 - ✓ Intensive and caring academic staff development
- ✓ Deep understanding for the need for context-driven learning and teaching as well as curriculum transformation

The UFS process



1st semester



Familiar content
(from NSC
Mathematics)

Quantitative reasoning course solutions designed to promote success in mathematics and to develop critical thinking and quantitative literacy.

2nd semester



Mostly unfamiliar
statistics-based
content

Statistical reasoning course solutions designed to teach mathematics skills essential for a growing number of occupations and needed for decision-making under conditions of uncertainty.

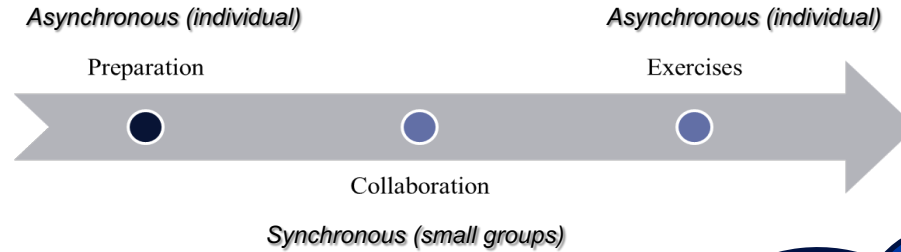


An adapted implementation at UFS in 2021

- Planned 2020 face-to-face implementation, imitating the Carnegie Math Pathways® programme in a South African context.
- COVID-19 led to an **online** implementation in 2021 at the UFS
(making small group learning possible in large classes)
- All BCom students enrolled
- NQF level 5; 16 credits per module
- Technological platform (Realizeit) integrates with BB.
- All learning materials are provided on the technological platform (no textbook required)



An adapted pedagogy



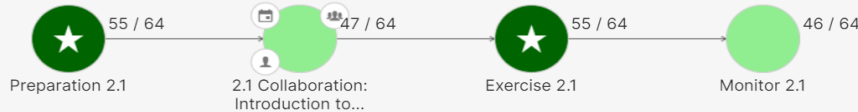
“The collaboration sessions are helpful because we get to discuss and share ideas on how to solve problems. We are exposed to new strategies. That is one valuable aspect about this module.”



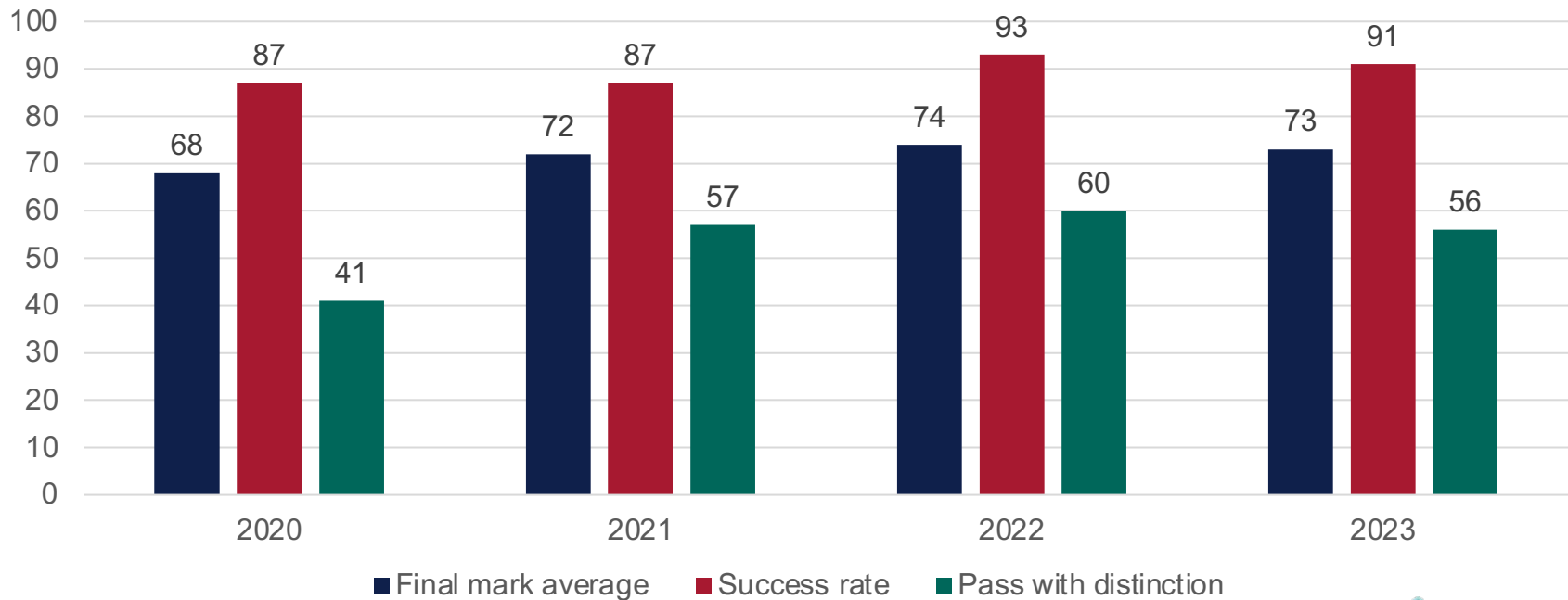
Roles / Statway College for UFS / Statway (G) [391R1K8Y] / Unit 2.1: Introduction to Probabilities

Unit 2.1: Introduction to Probabilities

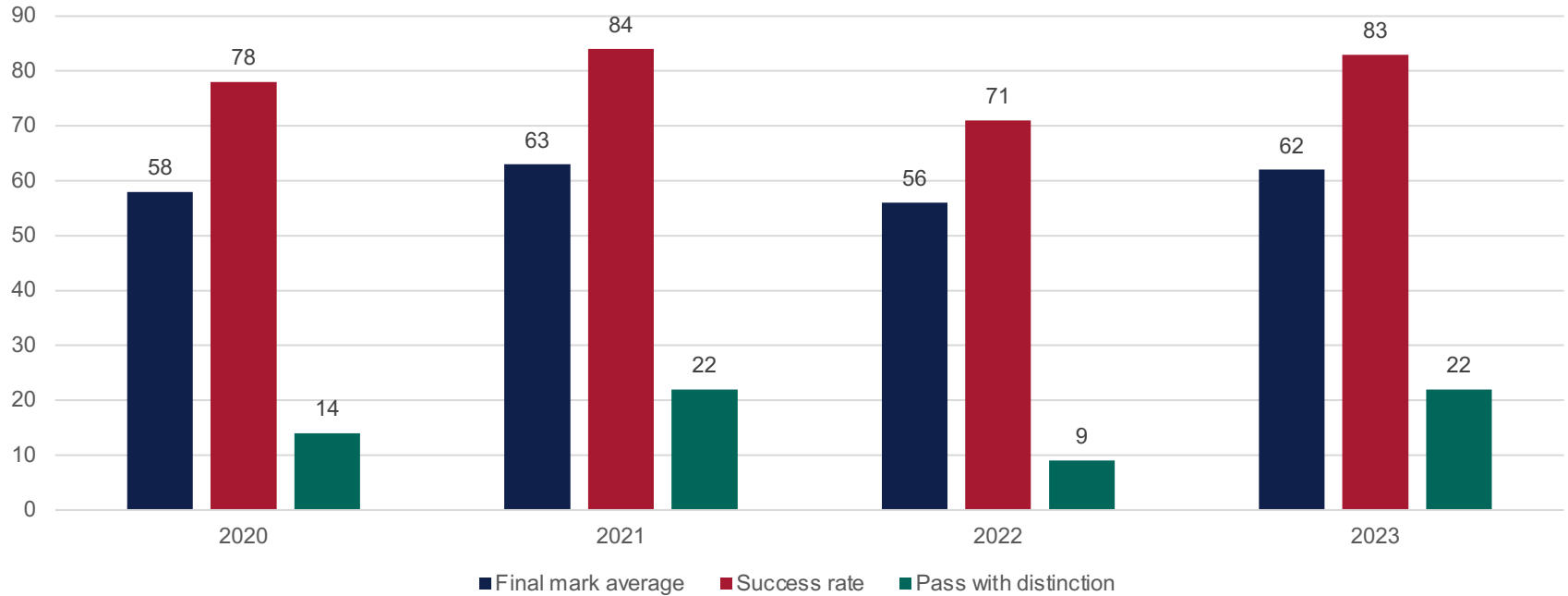
To Do Need To Know Learning Map Students Analytics



Quantway

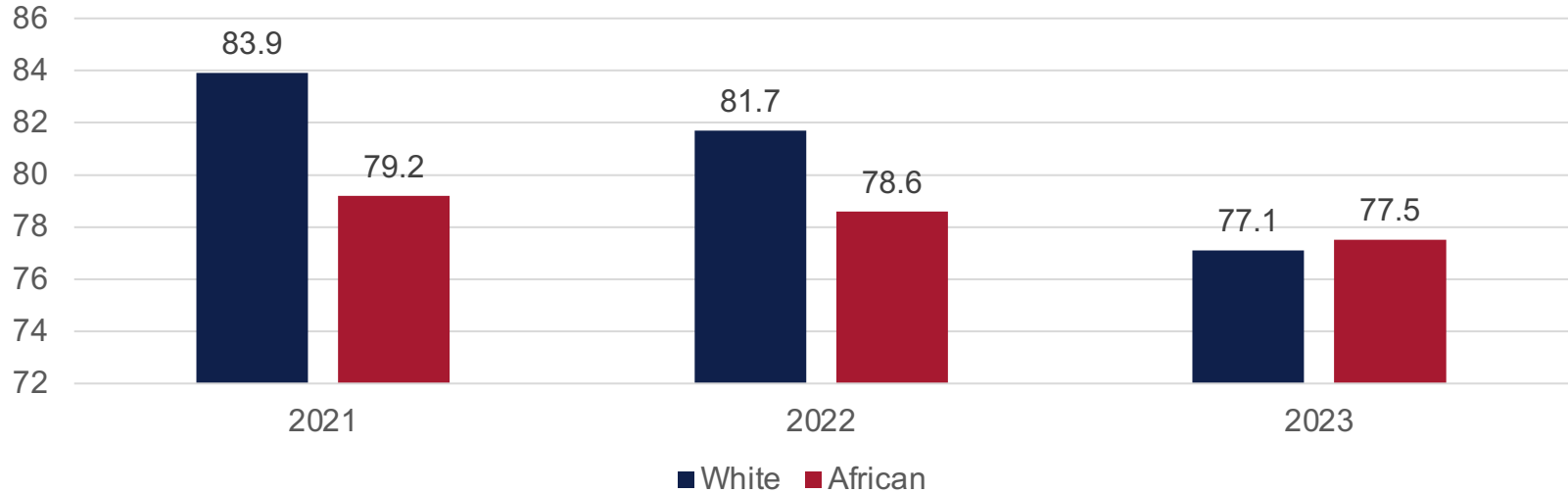


Statway



Equity gains

Average final marks



Economic & Management Sciences	2019		2020		2021		2022	
	Module pass rate	84.7% (white)	73.6% (black)	91.3% (white)	84.0% (black)	92.4% (white)	83.2% (black)	84.8% (white)



2021 cohort

Cohort module	Metric	P-value	Outcome
2022 EACC2608	10.46	0.001	Statistically significant
2022 ETXN 2708	5.5	0.018	Statistically significant
2022 ETXN2614	5.15	0.002	Statistically significant
2022 EMAC2714	4.6	0.017	Statistically significant
2022 EMIC2714	2.87	0.2	-
2023 EACC3708	4.11	0.001	Statistically significant
2023 ETXN2708	3.01	0.021	Statistically significant
2023 EMAC2714	2.93	0.033	Statistically significant
2023 EMFM3708	4.4	0.022	Statistically significant
2023 EACG2708	7.7	0.001	Statistically significant
2023 EINT3715	3.3	0.053	Statistically significant*
2023 EECM3714	8.3	0.008	Statistically significant
2023 ETAX3708	1.7	0.466	-
2023 EFIN3708	0.81	0.7	-
2023 EACG3708	-0.37	0.9	-



Contextualising for South Africa



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Contextualisation for the South African context

Minor contextualisation

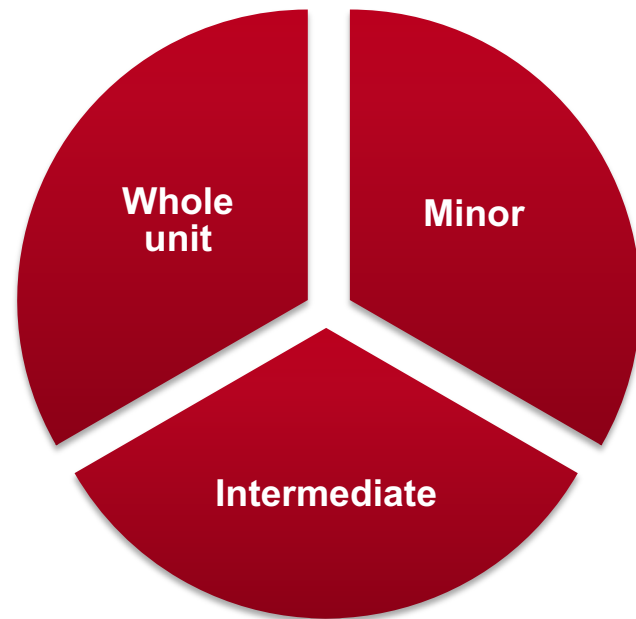
- Metric unit changes in preparation exercises and collaborations (not changed in (assessment) exercises, due to link with formal assessment)
- Phrases/ Words changed for context, e.g., Campus Principal changed to Rector, Faculty changed to Lecturer/ Academic staff

Intermediate contextualisation

- Questions/ Examples within units changed completely, e.g., baseball/ basketball to soccer/ rugby
- American states with e.g., population, changed to South African provinces with comparable population data
- Temperature/ Rainfall changed to South African areas with comparable weather conditions

Whole unit contextualisation

- US census-based unit changed to South African census-based unit (focusing on the availability of water and electricity in SA households)
- US cost-of-living unit changed to South African cost-of-living unit
- US wage-based unit changed to a unit based on the South African minimum wage



Process of contextualisation (cont'd)



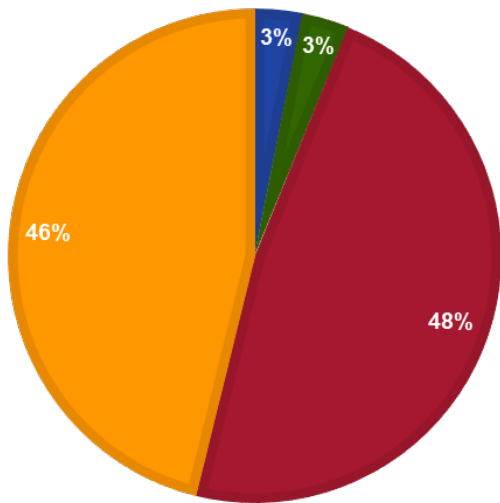
Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
I was more engaged and interested in units that used contexts specific to South Africa (n=271)					
91 (33.6%)	87 (32.1%)	57 (21%)	10 (3.69%)	17 (6.27%)	9 (3.32%)
I was engaged and interested in most of the units (n=269)					
92 (34.2%)	93 (34.57%)	67 (24.91%)	13 (4.83%)	3 (1.12%)	1 (0.37%)

“All the skills we learnt about quantitative reasoning, estimations, thinking flexibility, applying mathematical concepts to **different contexts and situations was extremely helpful** because it helps you understand that in real life there are some situations you can use estimations even though it might not be a mathematical problem or scientific problem or statistical problem; **things like figuring a budget for yourself, where should one go with regards to interest and tax rates.**”

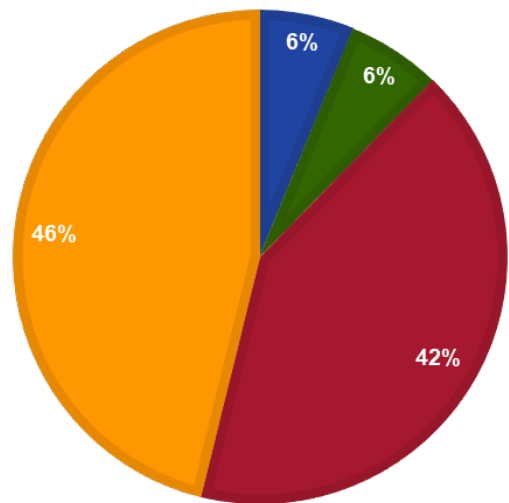
Process of contextualisation (cont'd)

Adapt over
three
iterations

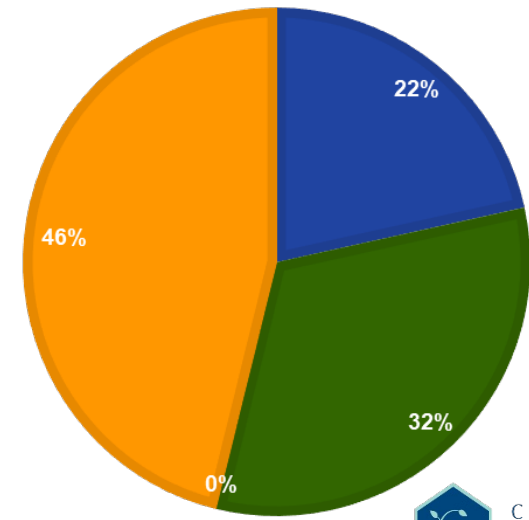
2021



2022



2023



Adding another dimension to contextualisation

“Explain to your group any other contexts (such as from your culture, community or history) where the concepts you learned today will also be relevant.”

Well I live on a farm and my father is obviously a farmer, we have cows so if we want to like when the cows gets ticks on their bodies we usually use a spray that kills the ticks and then sometimes we estimate what like how many water we need to throw in for the spray and how many substance we use to kill the ticks. So we usually use an estimation about that. On the bottle of the substance they would say use 5ml for an animal that weighs over 400kg and than imagine we have like let's say we have 800 cows and we need to like spray them all, so we not gonna like use make 800 sprays for each cow . So we gonna like use a big spray. So we can use some calculations to measure out how many substance we need and then how many water we need as well.

“In everyday life. we have to think about statements that were given, be it political statements, be it teenage pregnancy in our community and stuff like that.”

You can use this information when you starting look for a new job and you consider moving to towns, you can use this information to decide to which town you want to move to. The same information but different context when you are looking at the data.

“The concepts we learned today will be relevant in analysing me, other women, other people to check diabetes or obesity I will not be able to calculate the statistics or maintain my own die[t], I will look at the amount of fat in each food. The concepts learned will be helpful in maintaining a diet.”



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Quantway and Statway as Open Educational Resources

Dan Ray and Lewis Hosie

CC BY-NC license to encourage innovation

Student materials

Preparation 3.1
This section is for you to do before the content presentation. It will prepare you for the content presentation.

Equivalent Fractions
The fractions are equivalent if they have the same value or represent the same part of the whole.

3.1: Salary per Hour
Personal Finance, Medical Literacy

EXERCISE 3.1
Salary per Hour

MAKING CONNECTIONS TO THE COLLABORATION

DEVELOPING SKILLS AND UNDERSTANDING

SPECIFIC OBJECTIVES

Instructor notes

3.1
Personal Finance, Medical Literacy

CONTENT IN PRINT AND IN CLASS

ADDITIONAL TECHNOLOGY

REFLECT ON YOUR CLASS

Facilitation Notes and Solutions
3.1
Salary per Hour

INSTRUCTION NOTES

MAKING CONNECTIONS, MAIN IDEAS TO RECALL



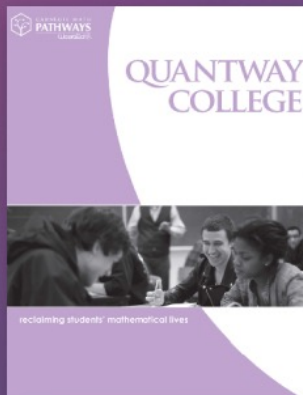
<https://oer.carnegiemathpathways.org/>



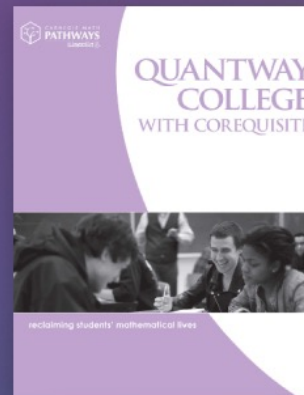
Course Solutions

Help students build critical thinking and introductory quantitative skills in this one-term course, with lessons grounded in quantitative literacy, numeracy skills, proportional reasoning, algebraic reasoning, mathematical modeling, and statistical thinking.

[Quantway Core](#)



[Quantway College](#)



[Quantway College
w/Corequisite](#)

Implementation Options

	1. Documents	2. Documents and LMS	3. QW/SW Courseware
Google Docs usage	Export as Word or PDF. Print or share with students.	Use Google Docs as source content to build in LMS.	N/A
Digital platform	N/A	LMS	Realizeit
Modality	Modality: face-to-face	Modality: hybrid; fully-online	Modality: hybrid; fully-online
Cost	No cost	No cost	\$39.99 (~R770) per student per term
Considerations	<p>Pros: no cost to students; no cost to institution; editable locally.</p> <p>Cons: no digital content; increased lift to administer paper-based curricular materials and assignments; grading.</p>	<p>Pros: no cost to students; no cost to institution; comprehensive course; editable locally.</p> <p>Cons: large-scale project; capacity and complexity of build; time; potential of reduced sophistication due to LMS limitations.</p>	<p>Pros: robust digital content; integrate with LMS; auto-grading and immediate feedback; variabilized content for additional practice; learning scaffolds for individual activities and collaborations.</p> <p>Cons: digital content not editable.</p>



Thank you
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