



## **IACESA International Conference – 22-24 February 2017**

**Conference Theme: The teaching of thinking:**

**Co-constructing and re-defining pathways to make an impact.**

Enhancing critical thinking dispositions in the mathematics classroom through a flipped learning approach

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# Objective

The objective of this research was to determine the impact of the **flipped classroom** as a pedagogical approach to the **critical thinking dispositions** of **second-year mathematics education students** at a South African university – in this case on the NWU – VTC.

# Background

## Frustrations:

- unsatisfactory throughput rates,
- low averages in mathematics,
- public image of mathematics as being a difficult subject,
- students studying to become mathematics teachers who perform badly at university,
- the Annual National Assessment results for Grade 9 in mathematics was 14 percent in 2013 (Anon. 2013),
- ....

# Background

## Reality:

- students taking mathematics as a major subject, often do not prepare for contact sessions, choose not to do their homework activities (Aalbers et al. 2013),
- perform poorly in tests and exams,
- often give up hope when confronted with the challenge of applying theory (Star 2015),
- teaching mathematics to large groups of students with varying mathematical abilities presents numerous challenges in any classroom.

# Reality



$$0 = 2$$

Proof:

$$0 = \frac{100 - 100}{100 - 100}$$

$$= \frac{10^2 - 10^2}{10(10 - 10)}$$

$$= \frac{\cancel{(10 - 10)}(10 + 10)}{10\cancel{(10 - 10)}}$$

$$= \frac{(10 + 10)}{10}$$

$$= \frac{20}{10}$$

$$= 2$$

# Background

## Thinking dispositions:

- One of the possible causes of poor performance is a lack of critical thinking and critical thinking dispositions that include truth seeking, perseverance, systematicity, problem-solving skills and an open mind.
- Critical thinking dispositions in mathematics refer to:
  - **the ability to search for alternative solutions to problems,**
  - **effective problem-solving strategies,**
  - **logical reasoning,**
  - **a systematic approach** and
  - **inquisitiveness.**



# What did we do?



# FLIPPED IT



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Source: <http://educacionvirtuall.blogspot.co.za>

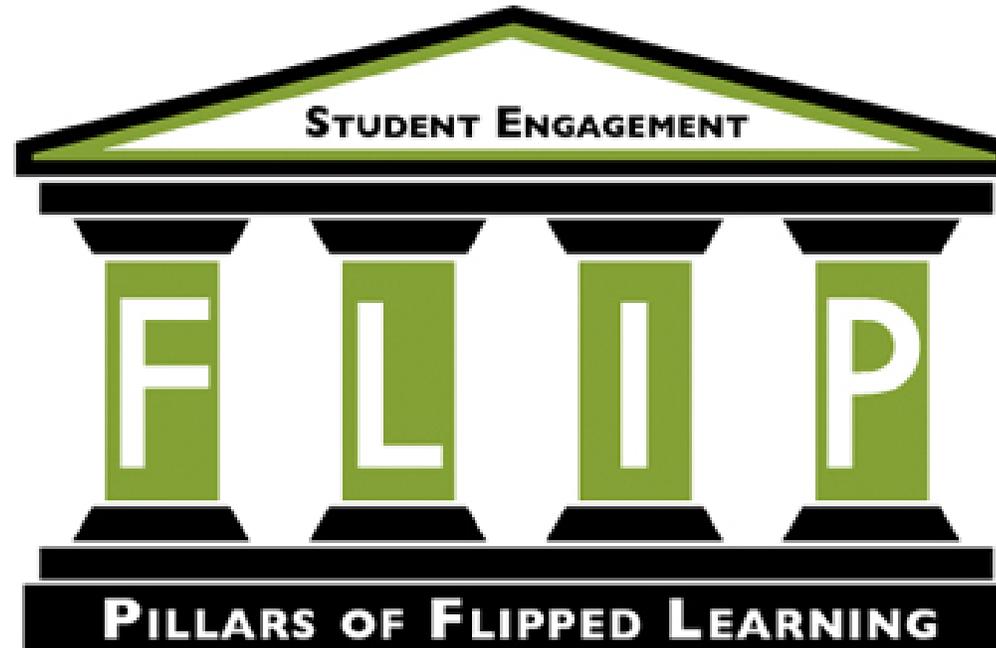
# FLIP - Pedagogical approach

## Definition

..pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.”

**NB** **Distinction** between a **flipped classroom** and **flipped learning**

# FLIP - Pedagogical approach



**NB - 4 pillars +11 indicators added to the 4 pillars for educators to use as self assessment as guidance measures for integration and implementation in their classes**

# FLIPped learning as pedagogical model

F

Flexible Environment

L

Learning Culture

I

Intentional Content

P

Professional Educator

# Research Question

- What is the impact of the flipped classroom as a pedagogical approach on the critical thinking dispositions of second-year mathematics education students at a South African university?
- *H A1* The flipped classroom as a pedagogical approach has an impact on students' dispositions.
- *H 01* The flipped classroom as a pedagogical approach does not have an impact on students' dispositions.

# Methodology

## ○ Design/Approach

- **Prior to contact session** - Concept videos were recorded – students had **to view explanations of new concepts** and examples – then **pause video and solve problems** using pen and paper –
- In some cases - **solutions** and in others cases only **correct answers provided**
- **Students** had to **create concept videos**

# Methodology

## ○ Data Collection

- Single-group, post-test-only design.
- flipped classroom pedagogical approach and model was used as an intervention,
- after which critical thinking dispositions on interaction, homework, problem solving and performance were measured,
- a small-scale explanatory, mixed method research was employed to gather data,
- quantitative - self-developed, closed questionnaire on a four-point Lickert scale, ranging from strongly agree to strongly disagree as measuring instrument,
- qualitative - narratives.

# Sample

- All the second year education students with mathematics as a major in the senior and FET phase (n = 28) at NWU-VTC.

# Ethical issues

- Discussed with students and a code was allocated to each student to ensure confidentiality and anonymity.

# Data Analysis

- Students' perceptions of their interaction in class,
- students' perceptions of homework and their preparation for contact sessions,
- students' perceptions of their own performance and problem-solving skills,
- Students' view of the flipped classroom.

# Results

## Guiding Question for research

To what degree will the flipped classroom in mathematics contribute to the encouragement of critical thinking dispositions through interaction, problem-solving strategies and the students' preparation in mathematics?

# Results - Quantitative

## Homework & Preparation

91% -strongly agreed they understood concepts better after having watched them on video before the contact session

87% - agreed it was easier to do homework after having watched the video

83% - I put in more effort than before my lecturer used the flipped approach

This approach allowed students to take responsibility, be prepared and gain value from problem solving in class instead of mastering concepts in contact sessions.

**(NOTE – ALL results reported in this presentation = Strongly agree +agree)**

# Results

## Problem Solving

87% - their knowledge of mathematics had improved

69 % - more confident about their understanding of mathematics

77% - agreed that they could use different problem-solving strategies and skills

The respondents' data revealed that their knowledge of mathematics had improved and that the flipped classroom supported their learning and higher-order cognitive skills.

# Results

## Interaction

95% - strongly agreed/agreed that they preferred more in-class learning activities

78 % - communicating with peers in class on problem solving more helpful after having watched the concept videos

Flipped classroom encourages students' habits of mind through interaction and classroom discussion.

# Results- Qualitative Data (Narrative)



Four pillars of F-L-I-P	Student feedback	Critical thinking dispositions
	<p><i>"...we got to do group work which brought us close and allowed us to share our thoughts with our peers acquire the skill of working together and to learn from each other."</i></p>	<ul style="list-style-type: none"> <li>*Sharing of ideas</li> <li>*Problem solving</li> <li>*Problem solving with clarity and precision</li> </ul>
	<p><i>"...I have a chance to see if I did understand and as the lecture is introducing the concept to us that's where some of the things become clear and the knowledge build up from where I did find difficulties during my preparation." – "I HAVE TO PREPARE FOR THE CLASS..."</i></p>	<ul style="list-style-type: none"> <li>*Truth seeking</li> <li>*Perseverance</li> <li>*Confidence in reasoning</li> </ul>
	<p><i>"..thought to myself this just will be a waste of time but when I sat down and watched the videos to prepare for class I realized that watching a video is better than using a book."</i></p>	<ul style="list-style-type: none"> <li>*Perseverance</li> </ul>
	<p><i>"...when I had questions I was able to bring them to the contact sessions and be answered, that is what I think helped us as students to understand.."</i></p> <p><i>"And on my side it also gave me time to reflect on my lesson..."</i></p>	<ul style="list-style-type: none"> <li>*Confidence in reasoning</li> <li>*Open-mindedness</li> <li>*Truth-seeking</li> </ul>

# Findings

## **Students who received flipped learning instruction in mathematics :**

- could successfully use higher-order thinking skills and problem-solving strategies,
- could also successfully use the approach to support their learning,
- easily adapted to the approach and strategies,
- successfully developed and applied critical thinking dispositions in in-class activities,
- showed confidence in using mathematics to reason and to solve problems, which is an integral part of all mathematics learning,
- re-watched the videos to gain a better understanding of concepts,
- achieved better results in the subject specific mathematics tests and examination.

# Limitations

Small-scale study and restricted to **one** university  
and **one** subject area - **mathematics** - at  
tertiary level, and  
therefore the results cannot be generalised

# Recommendations

- not the intention to advocate replacing the lecturer or traditional textbook or study material with online videos

But...

- to create **more opportunities for dynamic learning** through discovery and involvement,
- to **expand tasks performed by students** while watching concept videos,
- to, for example, **enrich concept videos** by using online tools which would allow questions to be added to the video.



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**THANK YOU!**

**QUESTIONS?**

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