

ENGINEERING

Fostering Inclusivity in Engineering Education in the South African Context

Shanali Govender, UCT

Shannon Chance, UCL

Inês Direito, UCL

Mohohlo Tsoeu, UCT



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD



UCL Centre for Engineering Education

Aims and structure

- Stimulate discussion and support the development of an action plan for change
- Co-creation around scaffolding from 4 pillar model for inclusive engineering education
 - Leadership and Culture change
 - Practice
 - Content
 - Delivery



Designing inclusion into engineering education

A fresh, practical look at how diversity impacts on engineering and strategies for change

July 2018



Ground Rules

- Respect: we will be respectful of each other
- When we state something as a fact that is really just our subjective viewpoint it can have the following impacts upon ourselves and others
- 1/x: in a group of x, you should only talk about 1/x of the time
- Vegas Rule: what's discussed here, stays here
- Ouch-oops: say ouch, say oops as needed



Introductions

- Your affiliation, primary interests, why registered
- What you hope to get out of the workshop

Survey:

https://docs.google.com/forms/d/e/1FAIpQLSePuWzr3WmulHWZVXyzNL4j_SWS7TSpLY8ASNfiiefC3O9sbg/viewform?usp=sf_link

Group discussion

- What is inclusivity in Engineering Education and what does it look like in the South African context?
- Who could be feeling excluded in our engineering programs—how and why?

What is inclusivity in Engineering Education and what does it look like in the South African context?



Who could be feeling excluded in our engineering programs—how and why?

Who is excluded? ^{Hist / Currently} Disadvantaged Ed background

- transitions - 1st, MAS, P+T
- gender (women, LGBTQIA+)
- 1st gen
- disability
- Language
- unfamiliar T3L
- People who feel excluded
- Race
- Cultural background
- Lack personal academic support
- Aptitude for eng.
- mental illness
- Introvert / Extrovert
- admin systems
- Geography - rural / urban, provinces
- Philosophy religion
- Different experiences - screwdrivers
- Affordability
- car
- People who don't feel ~ conserwah.
- Don't id as an eng student.
- Extended ~~gt~~ degree ^{eng} prog.
- Who can't relate to role-models

Group discussion... Imagining inclusion

- How would you define inclusive engineering education?
- How is inclusion defined in your institution?



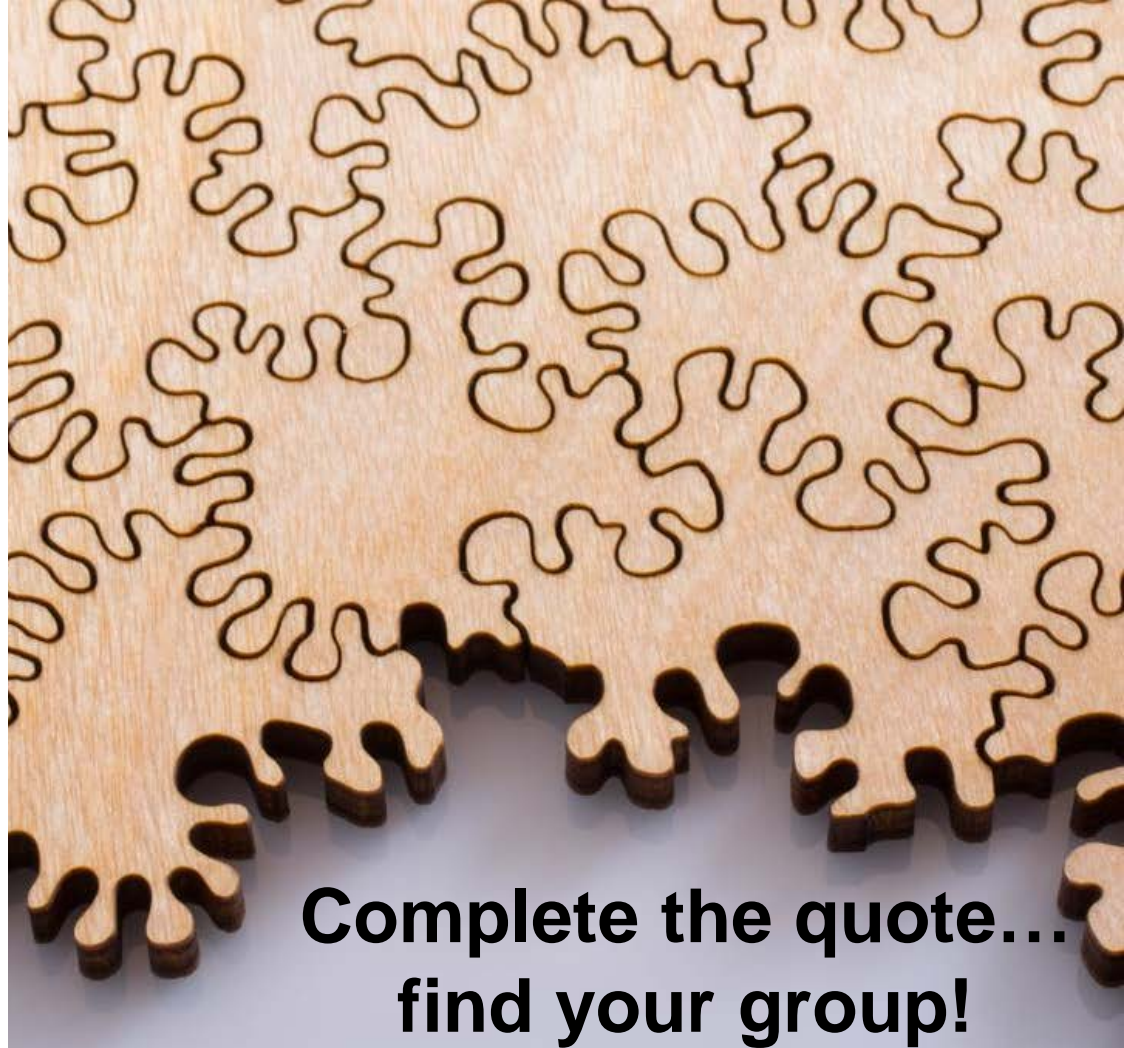
YOU are a piece 

of the *puzzle*
in someone else's life.

You may NEVER
KNOW where you fit,

but *others* will fill
the holes in their lives with

PIECES of YOU



**Complete the quote...
find your group!**

Delivery!



11:30 - 11:40	Complete the quote & From “Delivery” to “???”
11:40 - 12:10	An exercise in imagination (10+10+10)
12:10 - 12:45	Pedagogic choices - Success stories
12:45 - 13:00	Implicit Bias
13:00 - 14:00	Lunch
14:00 - 14:35	Designing Assessment for Learning
14:35 - 14:55	A pedagogic challenge - 15% solution
14:55 - 15:00	Wrap up

Delivery!

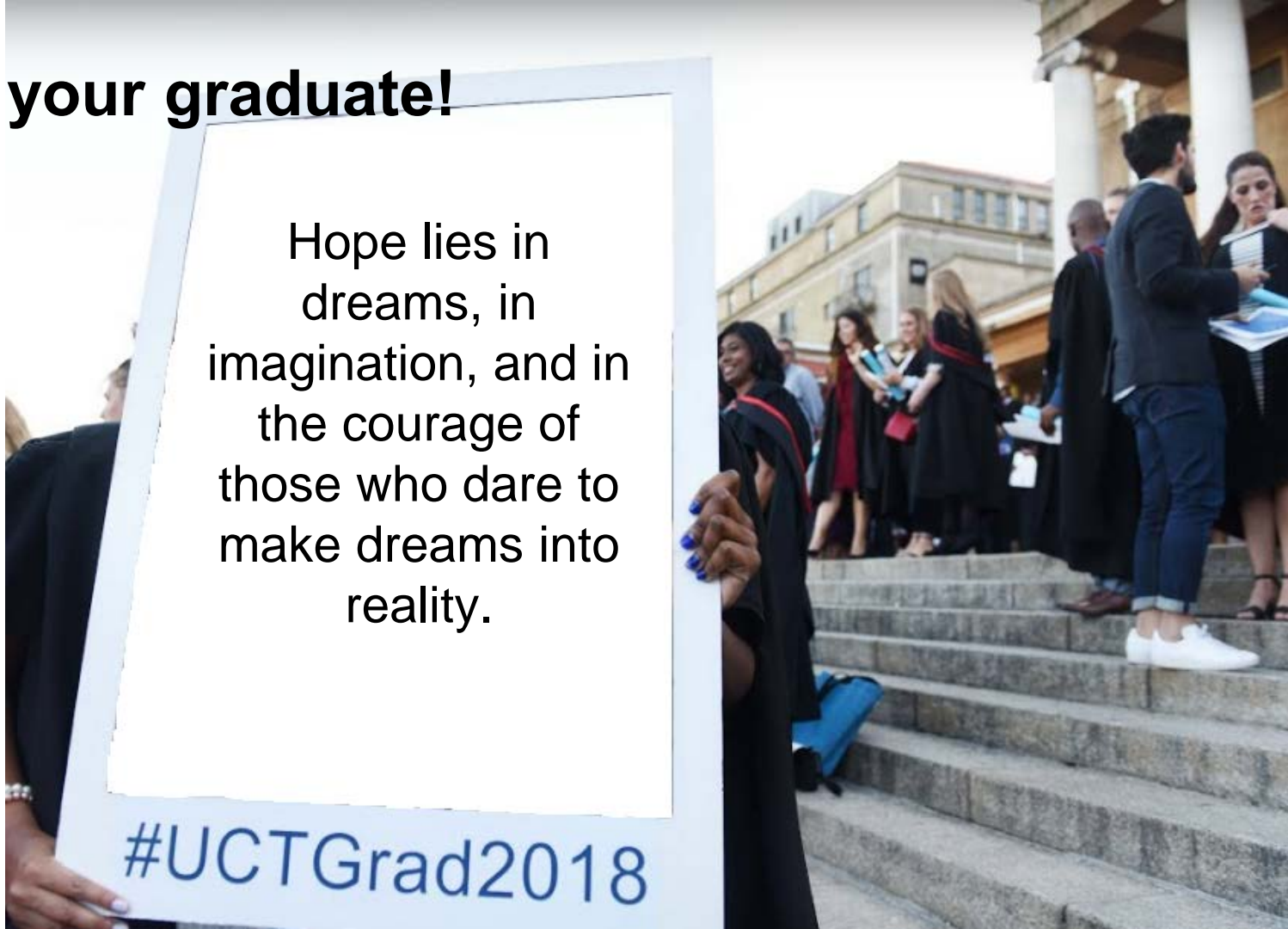
What's wrong with
that word?



Imagine your graduate!

Hope lies in
dreams, in
imagination, and in
the courage of
those who dare to
make dreams into
reality.

#UCTGrad2018





imagine an inclusive classroom

Imagination is the beginning of creation. You imagine what you desire, you will what you imagine and at last you create what you will.

- In your pairs,
 - Tell a success story.
 - Give each story a title.
- In your groups,
 - Share your insights.
 - List your insights on a chart.
 - Have one person ready to share with the group.



Implicit Bias



Sections

The Washington Post
Democracy Dies in Darkness

Sign In

\$4 for The Fourth

Video | Series | Top News Popular Live



(Ashleigh Joplin, Danielle Kunitz/The Washington Post)

Up next in Science

National

Can you change implicit bias?

May 25, 2018 | 8:22 PM EDT

"Think of implicit bias as the thumbprint of the culture on our brain." Harvard University social psychologist Mahzarin Banaji describes how institutions can effectively deal with bias.



Gender-Career IAT

Gender - Career. This IAT often reveals a relative link between family and females and between career and males.

Native IAT

Native American ('Native - White American' IAT). This IAT requires the ability to recognize White and Native American faces in either classic or modern dress, and the names of places that are either American or Foreign in origin.

Presidents IAT

Presidents ('Presidential Popularity' IAT). This IAT requires the ability to recognize photos of Donald Trump and one or more previous presidents.

Weight IAT

Weight ('Fat - Thin' IAT). This IAT requires the ability to distinguish faces of people who are obese and people who are thin. It often reveals an automatic preference for thin people relative to fat people.

Religion IAT

Religion ('Religions' IAT). This IAT requires some familiarity with religious terms from various world religions.

Skin-tone IAT

Skin-tone ('Light Skin - Dark Skin' IAT). This IAT requires the ability to recognize light and dark-skinned faces. It often reveals an automatic preference for light-skin relative to dark-skin.

Weapons IAT

Weapons ('Weapons - Harmless Objects' IAT). This IAT requires the ability to recognize White and Black faces, and images of weapons or harmless objects.

Arab-Muslim IAT

Arab-Muslim ('Arab Muslim - Other People' IAT). This IAT requires the ability to distinguish names that are likely to belong to Arab-Muslims versus people of other nationalities or religions.

Asian IAT

Asian American ('Asian - European American' IAT). This IAT requires the ability to recognize White and Asian-American faces, and images of places that are either American or Foreign in origin.

Age IAT

Age ('Young - Old' IAT). This IAT requires the ability to distinguish old from young faces. This test

Explore the data: Implicit Association Test



- ☰ Race IAT
- ☰ Gender-Science IAT
- ☰ Sexuality IAT
- ☰ Age IAT
- ☰ About the IAT
- ☰ About this dashboard
- ☰ Donate to Project Implicit

What is the Race IAT?

The Implicit Association Test (IAT) measures the strength of associations between concepts (e.g., Black people, White people) and evaluations (e.g., Good, Bad). A higher score indicates a greater preference for White people over Black people. These plots represent 7983 participants, which is a random sample of 0.05% of people who took the Race IAT between 2007 and 2016. The average IAT score for this overall sample is 0.311 (SD = .44) indicating a moderate implicit preference for White over Black people.

Who do you want to see the distribution of Race IAT-scores for?

Below, choose whether to graph IAT scores by participant race

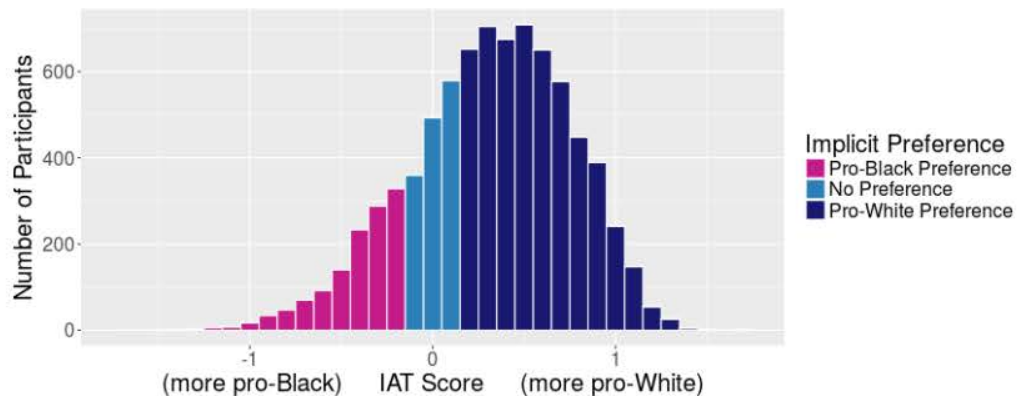
All

What demographic factors correlate with scores on the Race IAT?

Below, choose a variable to see its correlation with scores on the Race IAT

Age

How do people score on the Race IAT?



Do Race IAT scores correlate with other factors?

There is a negligible correlation between age and scores on the Race IAT, $r = -.029$, $p = 0.018$.

Pandora's box - A freewriting activity

I know that I have a bias
towards/ against...



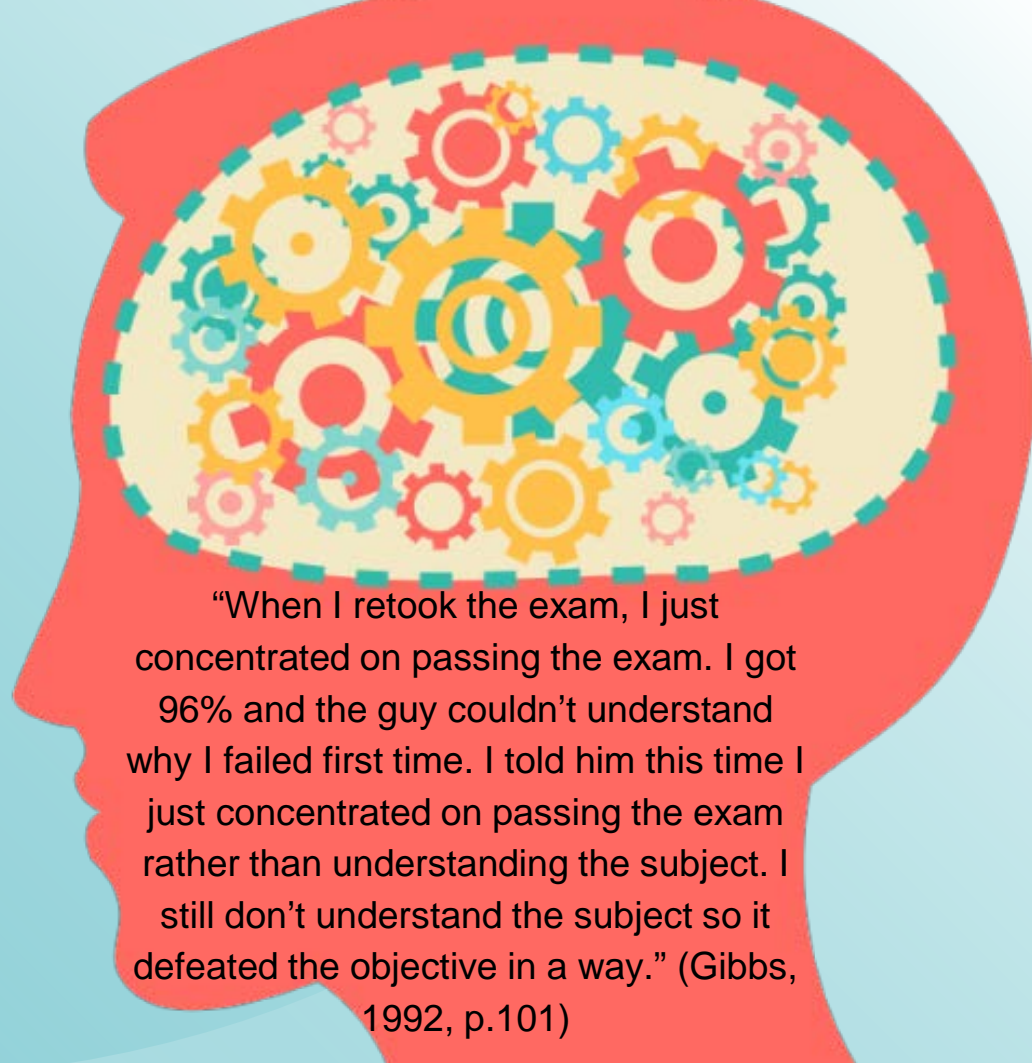


LUNCH?



YES!

“Assessment makes more difference to the way that students spend their **time**, focus their **effort**, and **perform**, than any other aspect of the course they study, including the teaching. If [lecturers] want to make their course work better, then there is more leverage through **changing aspects of the assessment** than anywhere else...” (Gibbs, 2010)



“When I retook the exam, I just concentrated on passing the exam. I got 96% and the guy couldn’t understand why I failed first time. I told him this time I just concentrated on passing the exam rather than understanding the subject. I still don’t understand the subject so it defeated the objective in a way.” (Gibbs, 1992, p.101)

What does assessment do?

- To check how much/what students know
- To grade performance; certificate
- To differentiate/ separate/ classify students
- To facilitate learning
- To promote/model thinking
- To assess our teaching
- To reflect on our purposes/aims/goals (Newton 2007)



Assessment (for learning)

- an integral component of instruction,
- located within **collaborative learning environments** that
 - engage **students as active participants** in the assessment and feedback process,
 - foster **meaningful, authentic engagement** with the discipline, and
 - support the development of **evaluative expertise** in students.

- Brainstorm all the assessments in a course.
- For each assessment answer the following:
 1. What is the purpose of the assessment task?
 2. What does the assessment task aim to assess?
 3. What format or shape does the task take?
 4. Who is involved in the assessment and how do they participate?
 5. How are students prepared for assessment?
 6. What happens with the products and outcomes of the assessment?



Mapping assessment practices

Date	Activity	Learning outcomes assessed	Format or shape	Feedback	Who is involved and how?	Products and outcomes?
Contact week	Daily reflection	Related to daily themes	Short reflective, blog post after conversation	Formative feedback, rubric for students, voice note from staff?	Peer & staff comments	Largely formative, work completed mark
Week 1	Learning design plan	LO 1, 2, 4	Template provided	Formative feedback, rubric for students, feedback on student doc in google docs?	Peer & staff comments	15% of final mark
Week 2	No assessment activity					
Week 3	Draft Design Rationale	LO 1, 3, 4, 5	Template provided	Extensive written and verbal formative feedback	Staff	Formative

(1) The purpose of the assessment task?

- **Diagnostic purposes:** identifies students' strengths and weaknesses for selection, admission and placement.
- **Formative purposes:** enhances learning by providing feedback to allow students to develop the valued knowledge, skills and attitudes of the discipline.
- **Summative purposes:** informs judgments about students' achievements for example, promotion and certification.
- **Evaluative purposes:** informs judgments about the quality of a course or programme for programme accreditation and departmental review.

(2) What does the assessment task aim to assess?

Cognitive



Characterization
by Value Set

Organization

Valuing

Responding

Receiving

Affective



Psychomotor

Non-discursive
Communication

Skilled
Movements

Physical Activities

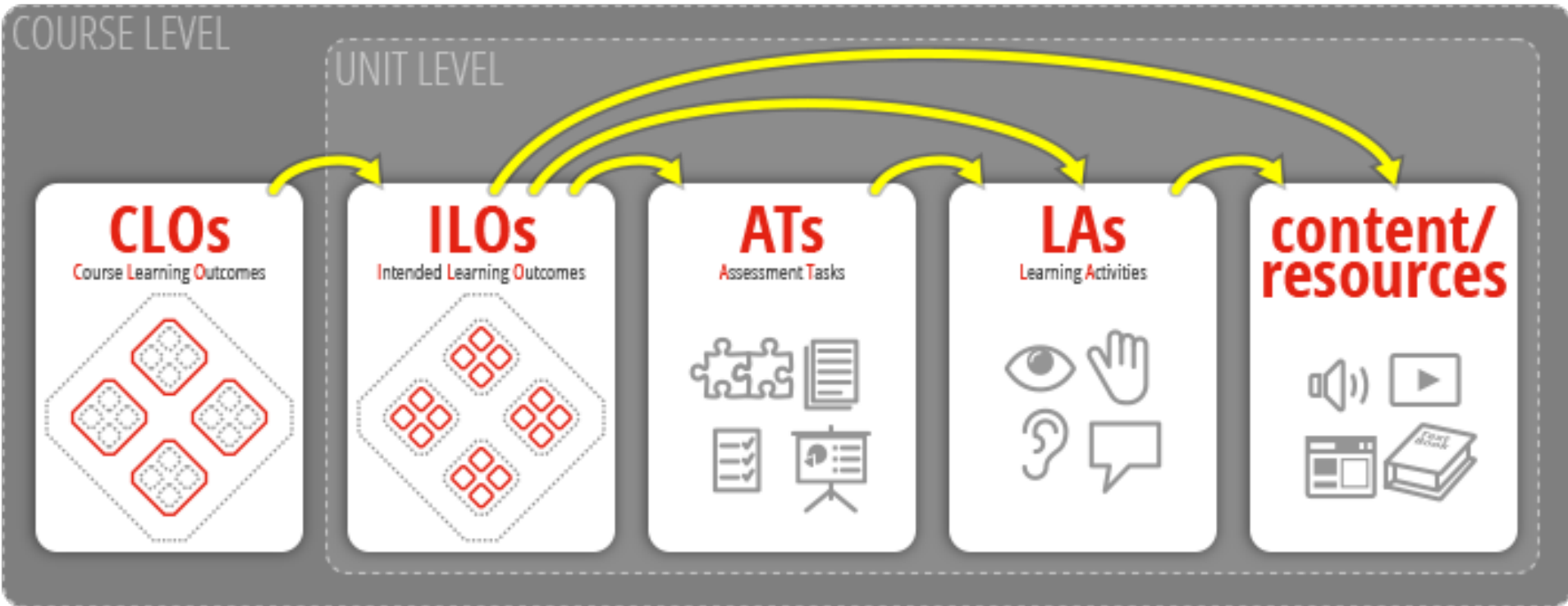
Perceptual

Basic Fundamental Movement

Reflex Movements



... (2) is there Constructive Alignment?



(3) Format or shape of the task?

- Group brainstorm - chart paper
- All the kinds of tasks we use...



(4) Who is involved and how?

Expert

Validity
Reliability etc



Peer

Tools
Feedback to their peers
Formal assessment
Impact on markers



Self

Opportunity to develop
judgement skills,
critiquing abilities and
self-awareness.



(5) How are students prepared for assessment?

(6) What happens with the product of assessment?



The journey
of a thousand miles
begins with
a single step.

Lao Tzu

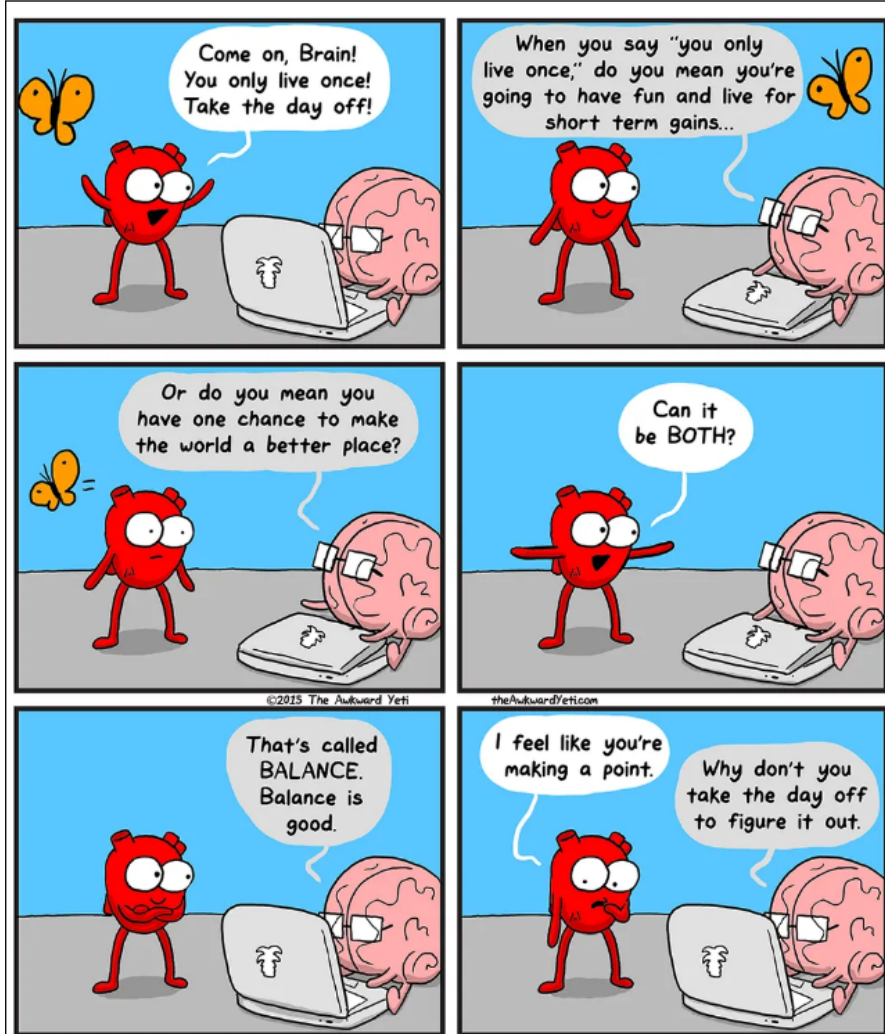
zooll.com

15% Solution

1. On your own, what's the inclusivity/classroom challenge you want to work on? (2min)
2. What's your 15% solution? (3min)
3. Share with your group. (15min)

Wrap up

- On a post it - something that's in your brain
- On a post it - something that's on your heart

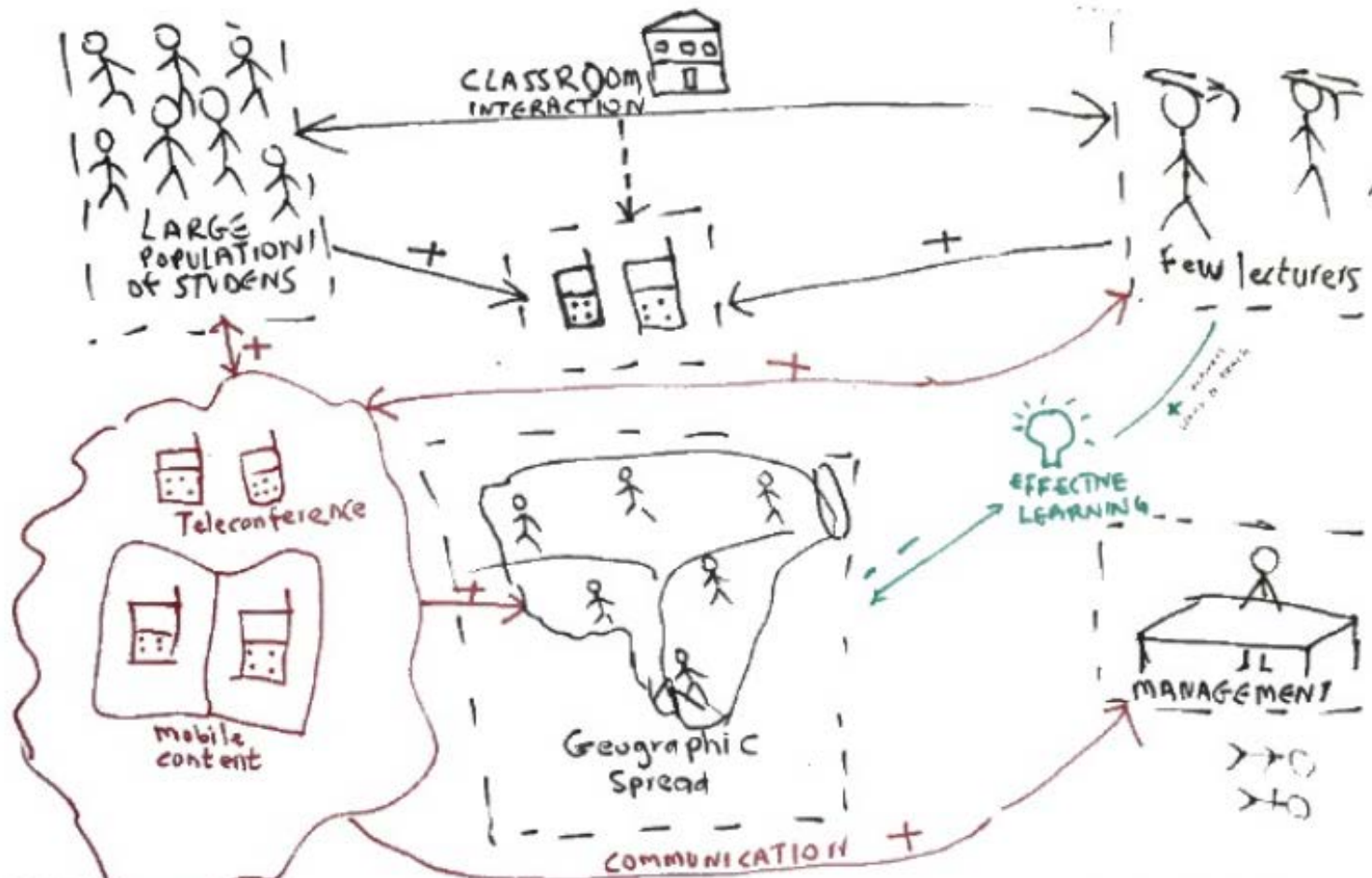


Extra slides

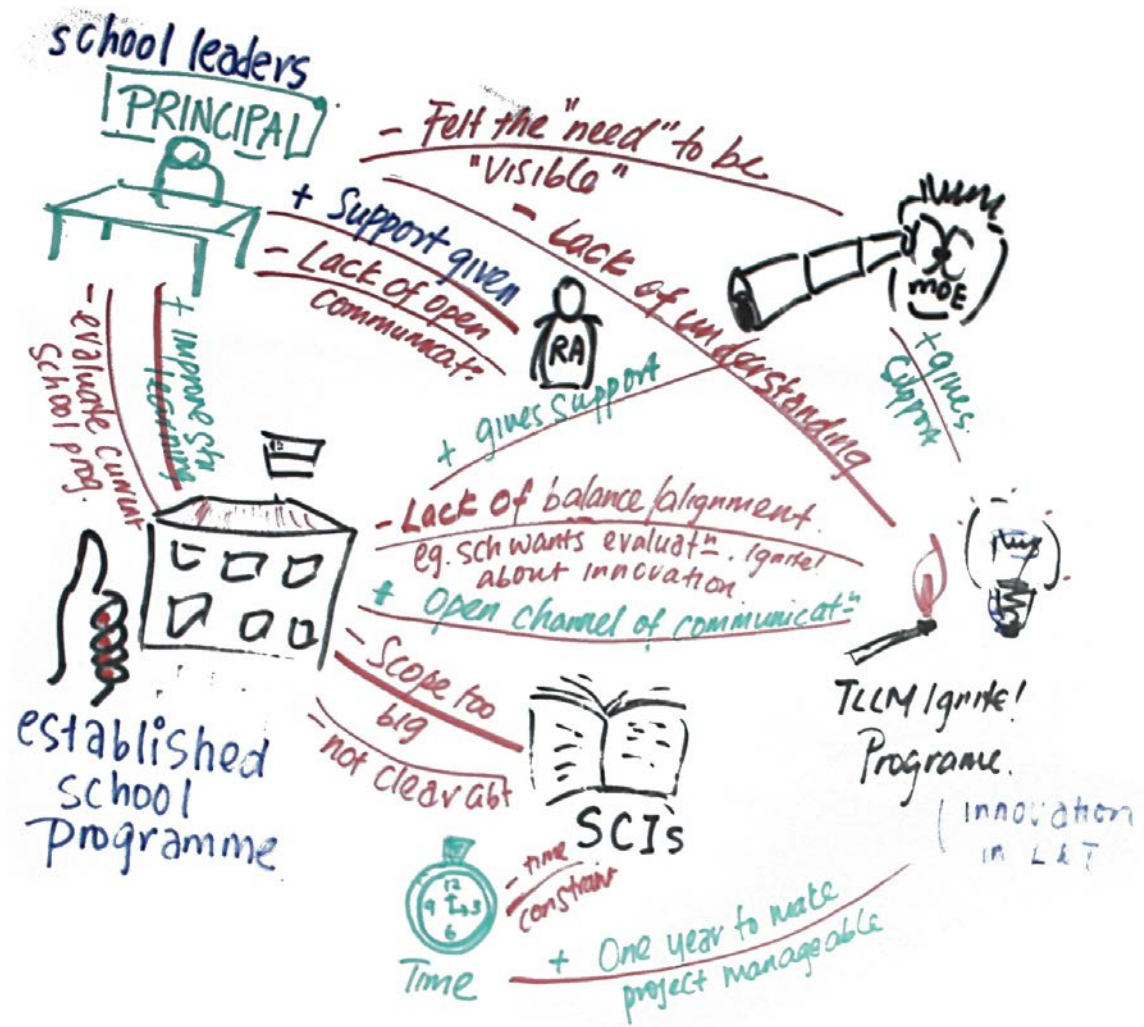
Force maps

- a graphical representation of the context of a design challenge
- includes iconic representations of
 - the key elements of the teaching and learning context (social, material and intentional factors)
 - the relationships between them - marked "+" when supportive, and "-" when indicating a tension.
- The design challenge can often be defined in terms of resolving some of these tensions.

Force Maps



Force Maps



Mapping your space

Step 1: List factors, concerns and “forces” in your context.

Step 2: Note the relations between the forces. Mark supporting relations with “+” and conflicting relations (or tensions) with “-”.

Step 3: Place your personas on the drawing canvas. Connect them to their concerns (represented by icons).

Step 4: What mediates between the personas and their concerns.

Appendix 1: Overview of development of Taxonomies and their domains

	Cognitive	Affective	Psychomotor
1950s	Blooms et al (1956) Cognitive	Blooms et al (1956) (1964) Affective	Bloom (1956) Dave (1967/70); Simpson (1966/72); Harrow (1972) Psychomotor
1960s		Krathwohl's et al (1964) Affective	
1970s			Dave (1970) Psychomotor
1980s	Biggs & Collis (1982) SOLO Taxonomy		
1990s	Anderson et al (2001) Cognitive with Knowledge dimension		
2000-10			Fink (2003) Foundational knowledge; Caring; Learning about oneself;

Cognitive

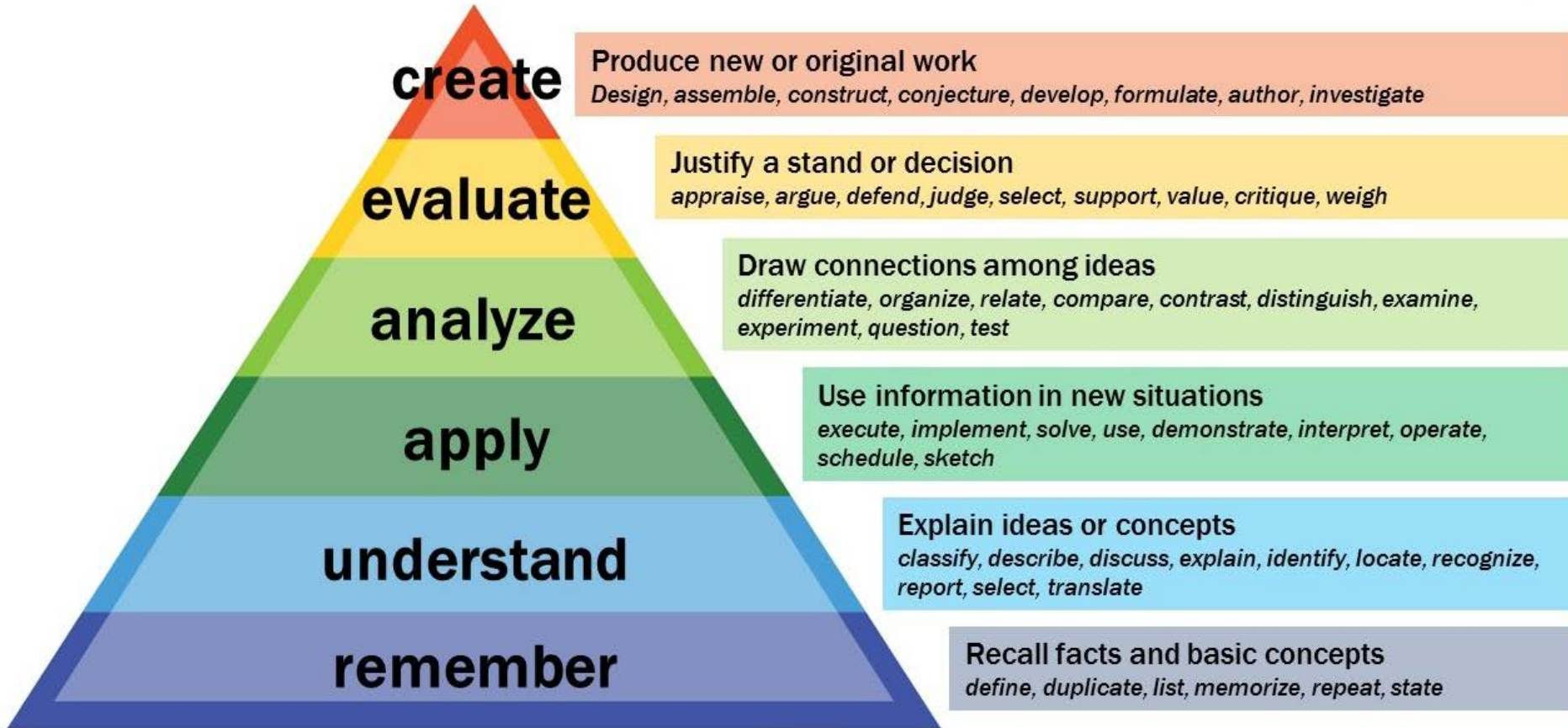


Affective

Psychomotor



Bloom's Taxonomy



Affective Domain (Feeling, Attitudes)

Receiving	Responding	Valuing	Organization	Internalizing
<p>Definition Selectively attends to stimuli.</p> <p>Sample Verbs</p> <ul style="list-style-type: none">. Accept. Acknowledge. Be aware. Listen. Notice. Pay attention. Tolerate	<p>Definition Responds to stimuli</p> <p>Sample Verbs</p> <ul style="list-style-type: none">. Agree to. Answer freely. Assist. Care for. Communicate. Comply. Conform. Consent. Contribute. Cooperate. Follow. Obey. Participate willingly. Read voluntarily. Respond visit. volunteer	<p>Definition Attaches value Or worth to something</p> <p>Sample Verbs</p> <ul style="list-style-type: none">. Adopt. Assume responsibility. Behave according to. Choose. Commit. Desire. Exhibit loyalty. Express. Initiate. Prefer. Seek. Show concern. Show continual desire to. Use resources to	<p>Definition Conceptualizes the value and resolves conflict between it and other values.</p> <p>Sample Verbs</p> <ul style="list-style-type: none">. Adopt. Adjust. Arrange. Balance. Classify. Conceptualize. Formulate. Group. Organize. Rank. Theorize	<p>Definition Integrates the Value in to a Value system That controls Behavior.</p> <p>Sample Verbs</p> <ul style="list-style-type: none">. Act upon. Advocate. Defend. Exemplify. Influence. Justify behavior. Maintain. Serve. Support

Acts consistently due to an internal belief,
Can articulate a philosophy or world-view,
Can break down complex situations and
respond accordingly based on values, develops
and lives by a code of personal behavior

Characterizing

Values become systematic, can compare
and contrast values and choices,
begins to order and prioritize values,
chooses to commit to certain
values and behaviors

Organizing

Motivated to invest, Chooses to behave in a
certain way frequently, Begins to identify
with a behavior and commit to it

Valuing

Willingly participating,
obedient, volunteers, finds
satisfaction in participating,
ready to respond

Responding

Willing to be aware of the
setting or situation, gives
attention by choice,
open to the
experience

Receiving/Attending

by @henrythiele

Table 2: Affective Domain

Level	Characteristic	Some Verbs
Receiving	Developing awareness of ideas and phenomena	Ask Follow Reply Accept Prefer
Responding	Committing to the ideas etc by responding to them	Answer Recite Perform Report Select Follow Explore Display
Valuing	Being willing to be seen as valuing certain ideas or material	Justify Propose Debate Relinquish Defend Initiate
Organization and Conceptualisation	To begin to harmonise internalized values	Arrange Combine Compare Balance Theorize
Characterisation by Value	To act consistent with the internalised values	Discriminate Question Revise Change

Psychomotor Domain (Doing, Skills)

Perception	Set	Guided Response	Mechanism	Complete Overt Response	Adaption	Organization
Definition Senses cues that guide motor activity Sample Verbs . Detect . Hear . Listen . Observe . Perceive . Recognize . See . Sense . Smell . Taste . View . Watch	Definition Is mentally, emotionally, and Physically ready to act. Sample Verbs . achieve a posture . assume a body stance . Establish a body . place hands arms etc. . position the body . sit .stand . station	Definition Imitates and practices skills, often in discrete steps Sample Verbs . Copy . Duplicate . Imitate . Manipulate . Guidance . Operate under . Supervision . Practice . Repeat . Try	Definition Performs acts with increasing efficiency confidence, and proficiency Sample Verbs . Complete with confidence . Conduct . Demonstrate . Execute . Improve efficiency . Increase speed . Make . Pace . Produce . Show . Dexterity	Definition Performs automatically. Sample Verbs . Act habitually . Advance with Assurance . Control . Excel . Guide . Maintain efficiency . Manage . Master . Organize . Perfect . Perform . Automatically	Definition Adapts skill sets to met a problem situation Sample Verbs . Adapts . Reorganizes . Alters . Revises . Changes	Definition Creates new patterns for specific Situations. Sample Verb . Design . Originates . Combines . Composes . Constructs

Psychomotor Domain

(Bloom, 1956; Simpson, 1972)

Suggested by Bloom, 1956 with categories created by Simpson, 1972

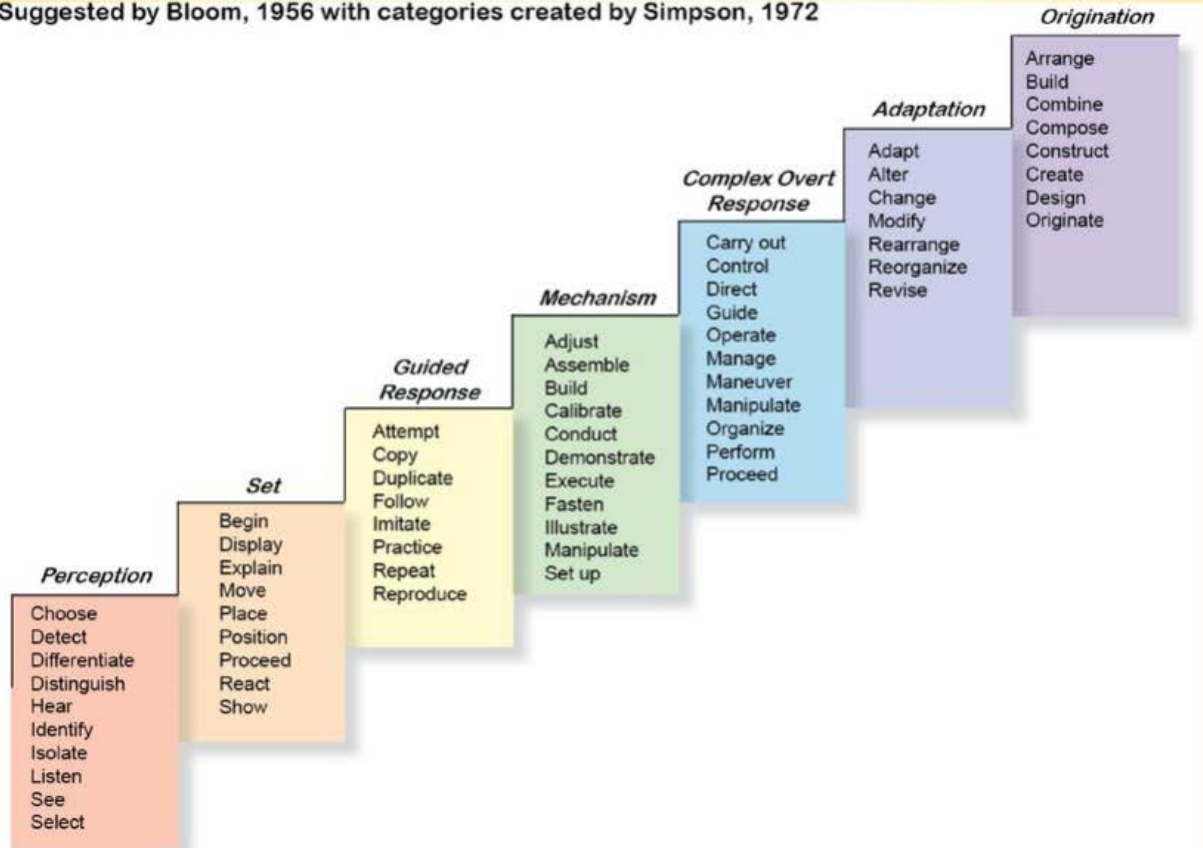


Table 3 Psychomotor Domain

Level	Characteristic	Some Verbs
Perception / Observing	Here the student is simply observing the procedure	Observe Listen Detect
Guided Response / Imitation	The student can follow instructions but needs to be instructed	Copy React Follow Reproduce
Mechanism	This is an intermediate stage where proficiency and confidence are growing	Organise Manipulate
Complex response	Proficiency has grown and performance is quick and accurate with little or no hesitation	The verbs are essentially the same as Mechanism, but modified by 'accurately' or 'quickly'
Adaptation	The student has such ability that they can combine and integrate related aspects of the skill without guidance	Reorganise Alter Rearrange Vary Internalise
Origination	The student has internalized automatic mastery of the skill	Compose Construct Design Initiate Create



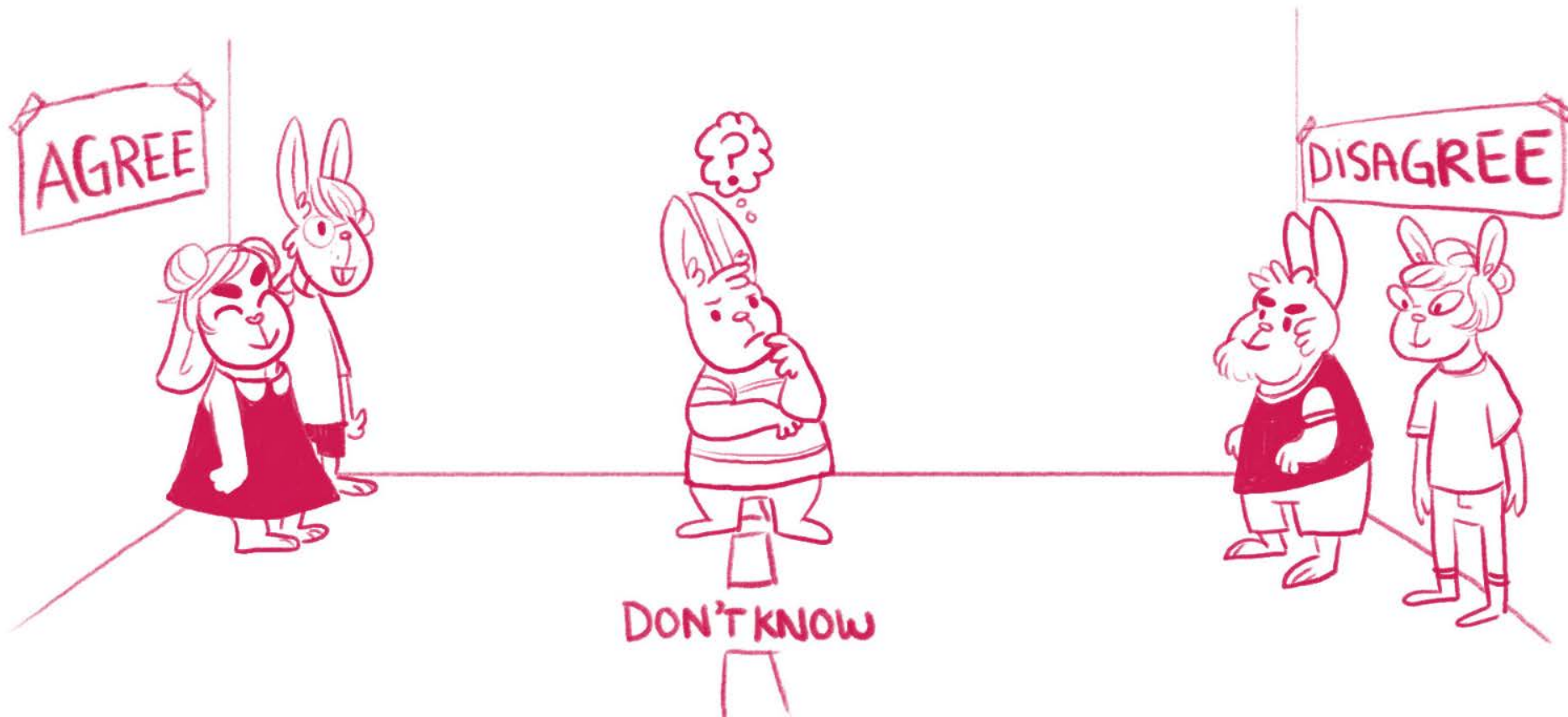
Barriers to learning

Inês & Shanali
11:00 - 12:30

Agenda

11:00 - 11:10	Human spectrogram
11:10 - 11:40	Building a (shared) (theoretical) language
11:40 - 11:45	Identifying barriers
11:30 - 11:45	Lessons from the literature
11:45 - 12:20	Working with cases
12:20 - 12:30	Wrap up

Human spectrogram





Activity: Building a language

1. Prejudice & Bias
2. Inclusivity
3. Diversity
4. Social Justice
5. Transformation
6. Decoloniality
7. Equity & Equality
8. Privilege
9. Intersectionality
10. Positionality

Key concept: Positionality

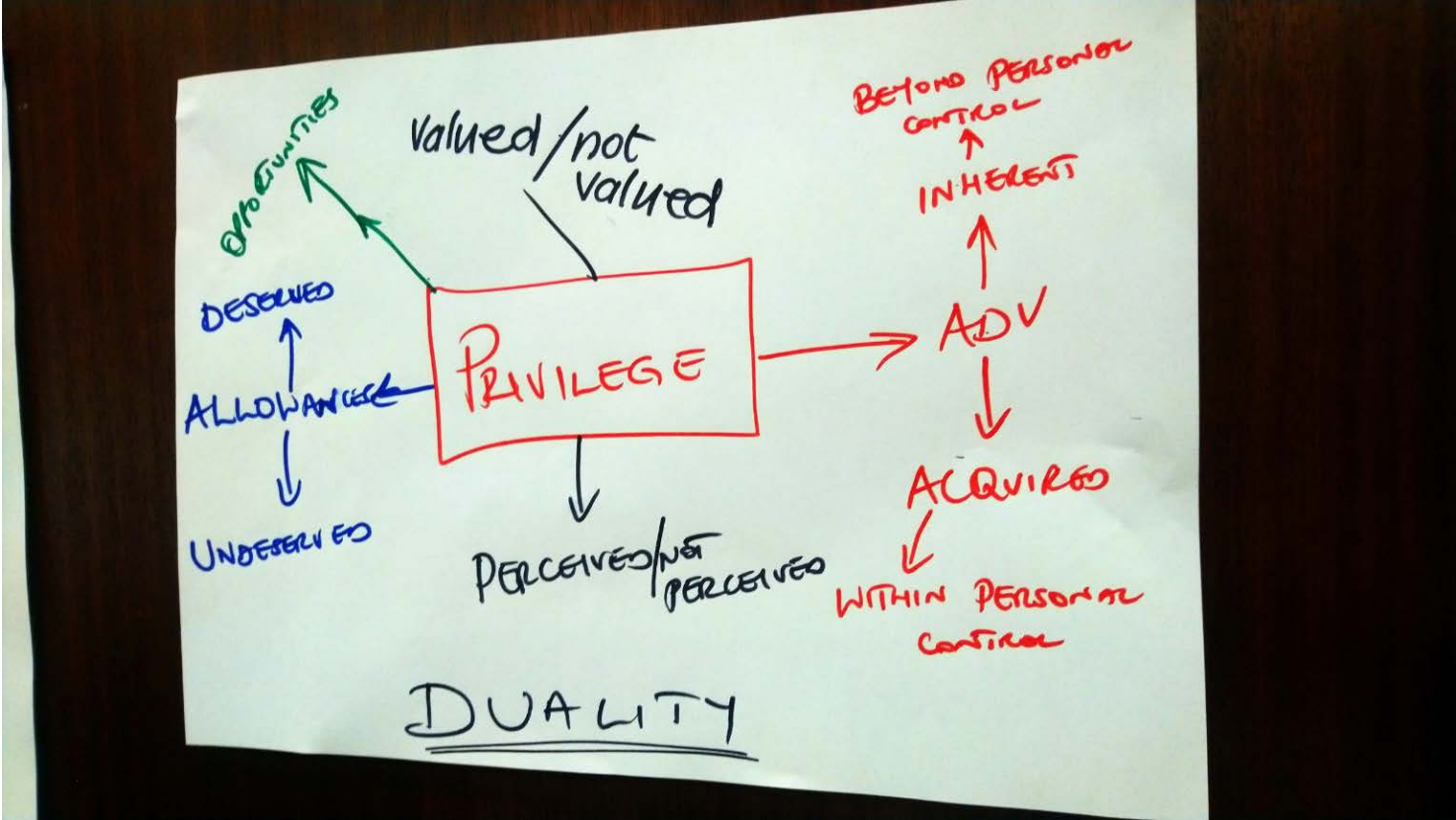
Positionality

- Self - identity
 - Position in society
- race
class
gender
sexuality
ability
status

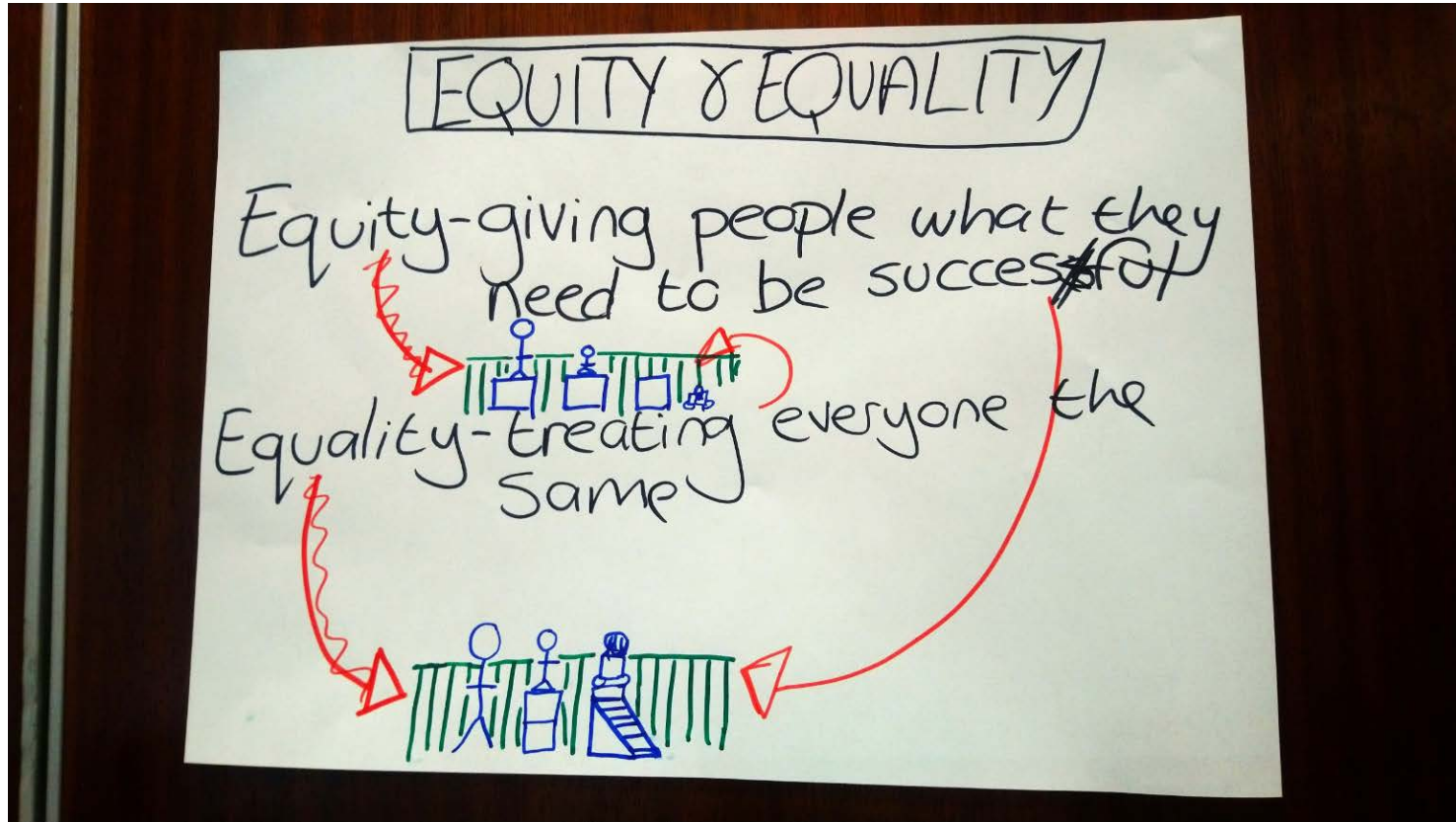
Key concept: Intersectionality



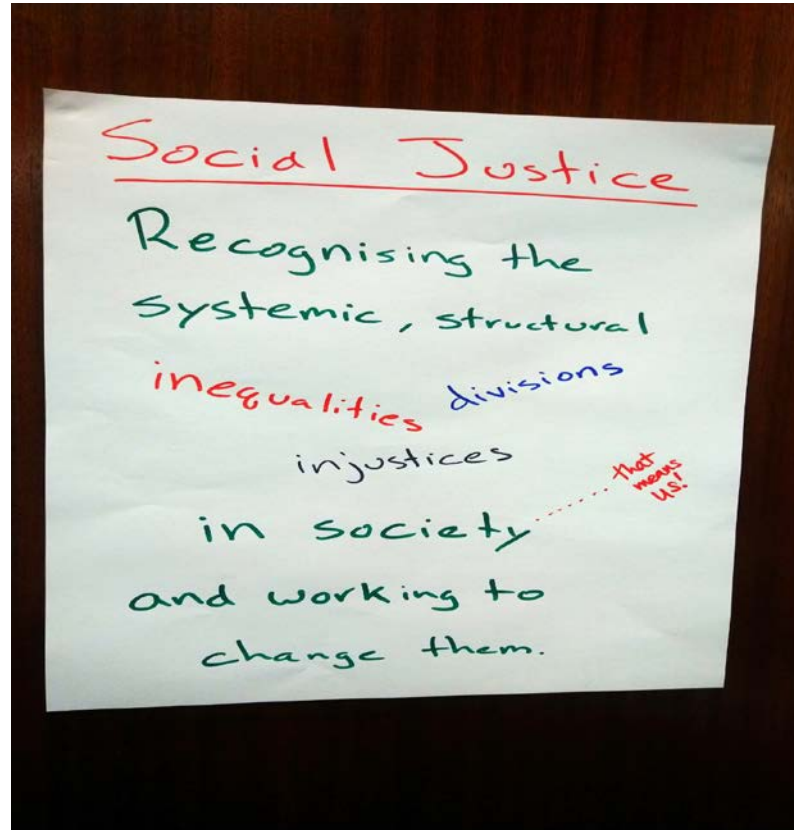
Key concept: Privilege



Key concepts: Equity & equality



Key concept: Social justice



Key concept: Diversity

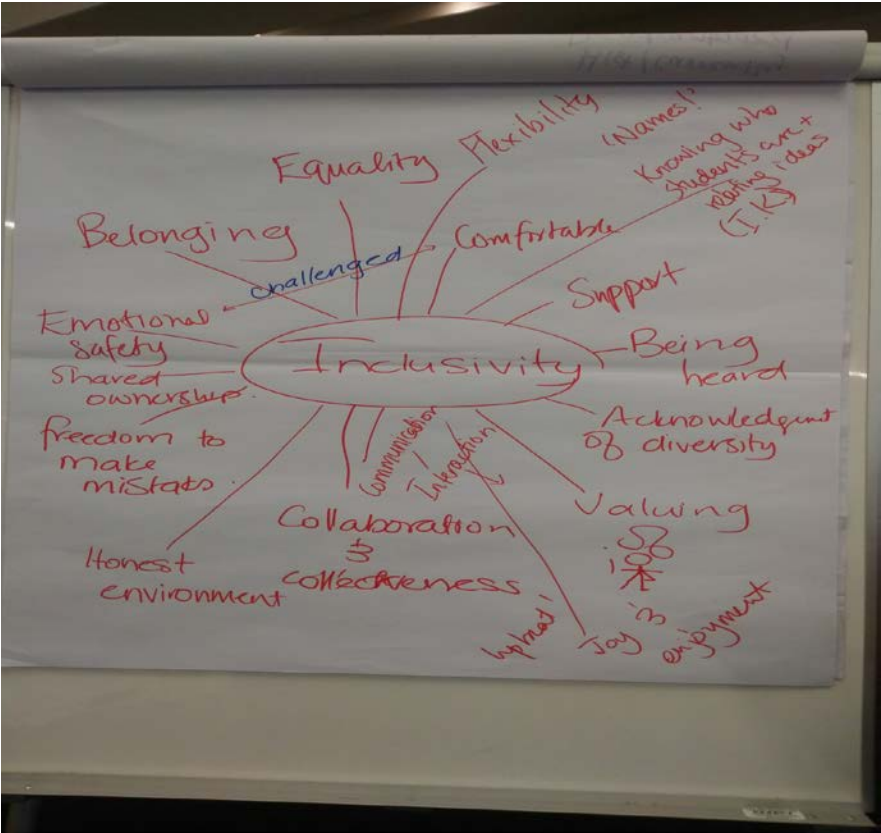
DIVERSITY

- Understanding each individual is ~~different~~^{unique} & recognising our individual differences

→ recognise & acknowledge
(self awareness)

& accept differences

Key concept: Inclusivity

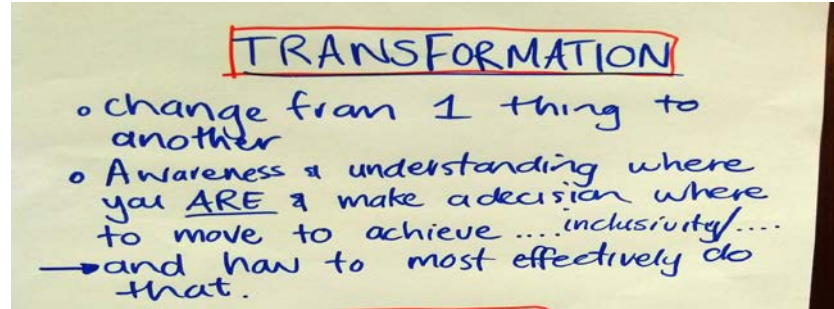


Key concept: Decoloniality

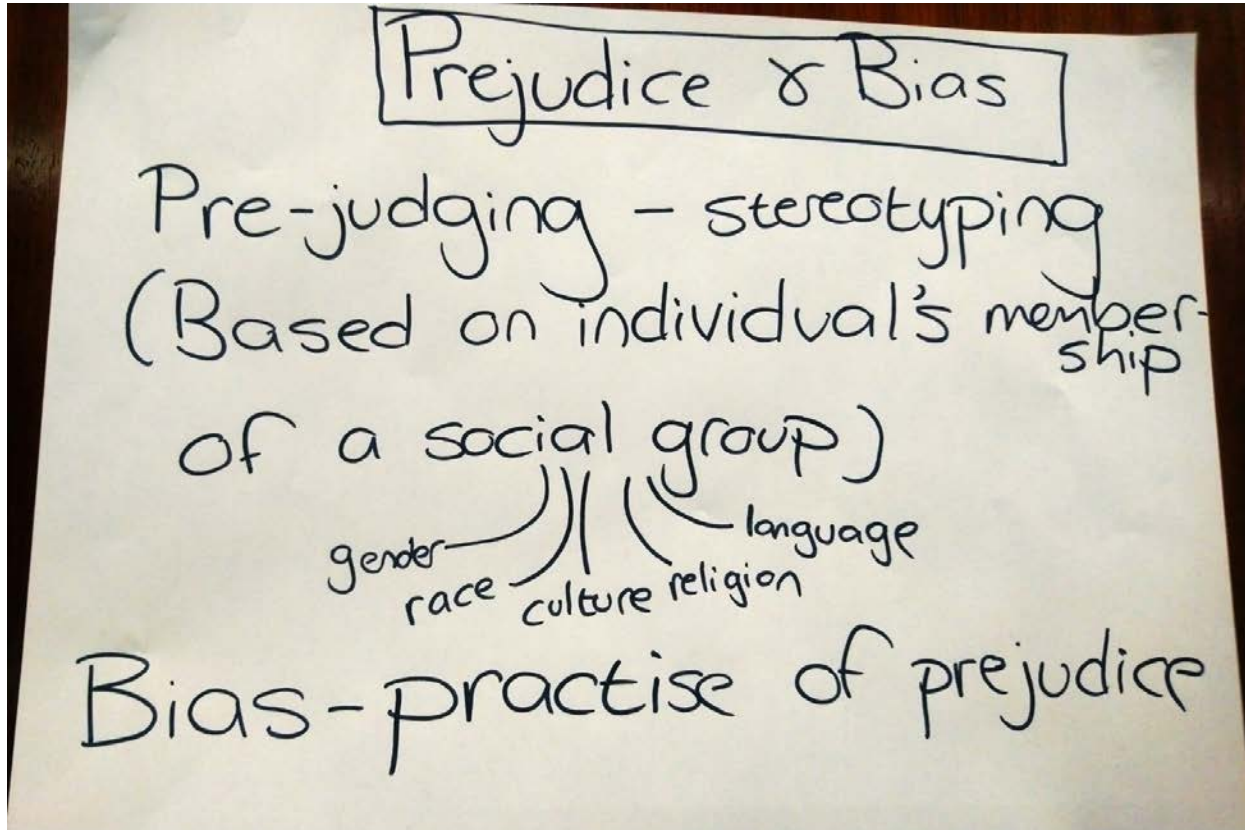
DECOLONIALITY

Developing & evolving old
Sets of rules, regulations, acts
~~being used~~
~~imposed~~ during minority
rule, to include diversity
& preservation of tradition
al systems through science &
engineering^{td}

Key concept: Transformation



Key concept: Prejudice and Bias



Positionality

“... stance or positioning of the researcher (educator) in relation to the social and political context of the study (context of teaching) - the community, the organization or the participant group” (Coghlan & Brydon-Miller, 2014)

“The notion of positionality rests on the assumption that a culture is more than a monolithic entity to which one belongs or not (...) Positionality is determined by where one stands in relation to ‘the other’ (...)", however, these positions can shift (Marriam et al., 2001)

By exploring facets of our own personal perspective or positionality, we can begin to more adequately understand the phenomenon of interest involving individuals with different life experiences than our own.

Intersectionality

“... a way of mediating the tension between assertions of multiple identity and the ongoing necessity of group politics (...) Through an awareness of intersectionality, we can better acknowledge and ground the differences among us and negotiate the means by which these differences will find expression in constructing group politics.” (Crenshaw, 1991)

Privilege

Privilege refers to unearned advantages that accrue to us that we are able to take for granted.

Most privileges are contextually specific

Privilege is often invisible to those who have it, while simultaneously apparent to those who lack that particular kind of privilege.

“One privilege of the privileged is not to see their privilege.” (Acker, 2006)

Equality & Equity

Equality usually adopts a ‘one-size-fits-all’ strategy

Equity is an expression of social justice

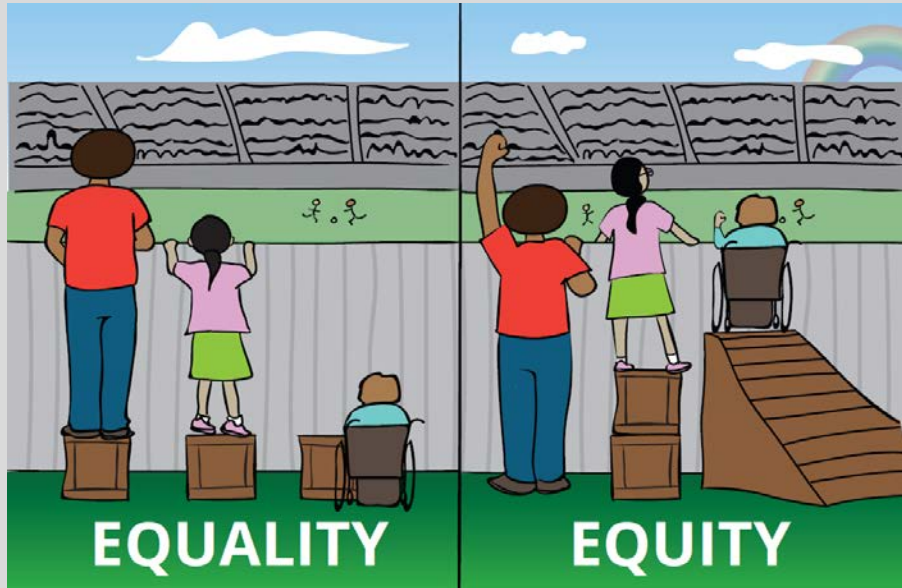


Image courtesy [Maryam Abdul-Kareem](#)

Social Justice

Social justice practices, including those by engineers, should attempt to an equal distribution of rights, opportunities and resources in order to enhance human capabilities and reduce the risk and harms among the citizens of a society.

(Lucena, 2013)

Diversity

“...considers similarities and differences in terms of age, ethnicity, disability, gender and religion; and less visible differences such as sexual orientation, disability [also], religion, educational background, personality type, nationality etc.”
Royal Academy of Engineering

Diversity is a characteristic of *groups*, not individuals

Inclusion

“...is about the culture, environment and processes created by an organisation. It is measured by how people feel and it needs effort to achieve. Creating a culture of inclusiveness is about establishing behaviours that support inclusion.” Royal Academy of Engineering

Decoloniality

Decoloniality can best be understood as a call for a type of cognitive justice based on an overhaul and expansion of the Western knowledge canon. The call is also for knowledge pluralisation, which refers to the incorporation of the complex ways of knowing of subaltern and all previously excluded groups (Fataar and Subreenduth 2015).

Identifying barriers



<https://tinyurl.com/EBE2019>

Access code: Barriers2019

Lessons from the literature

White male engineers feel that the culture of engineering is more inclusive than female engineers who in turn feel that it is more inclusive than engineers from Black, Asian and Minority Ethnic (BAME) backgrounds

“Creating cultures where all engineers thrive - A unique study of inclusion across UK engineering” (Royal Academy of Engineering)



Lessons from the literature

Underlying barriers to progress on inclusion in engineering:

- The “inclusion privilege”
- The perception that there is no ‘crisis of inclusion’
- The need to deliver progress on intangible outcomes related to perception and experience which may be at odds with engineering culture

Lessons from the literature

- Inclusivity in engineering education - multidisciplinary approach

Example: Research on Empathy in Engineering Education

increased empathy can contribute to communication, design processes, professional success, ethics, and the overall culture of engineering

ELEMENTS OF EMPATHY WHEEL



- Self-awareness, emotional expression and a sense of personal responsibility
- Respect for differences in interests, needs, and culture
- Healthy and thoughtful interactions with peers
- A sense of personal agency, leadership, and accountability within a group

Working with case studies

Examine your case study in light of the following:

1. What do you need to find out about the situation?
2. Who do you need to involve?
3. Does your institution have any policies or resources that are of relevance in relation to this case?
4. What possible responses are open to you?
5. How might your positionality impact on your choices in relation to this case study?
6. How might the concept of intersectionality help you to understand what is happening in this case study?



Case Study – Quick hands

Chao observed a problem in her course: when she asked a question, very few students offered to answer it. The students who did want to speak would typically sit in the front of the class, shoot up their hands to answer every question, and blurt out comments. Because these few hands shot up in the air so quickly, other students did not seem inclined to speak.

What would you suggest she do?



Case Study – Always in a rush

Sarsha runs a weekly tutorial for her Mathematics for Engineers course. Students may work in groups during the tutorial and are required to hand in the work immediately after. She notices that Sean is always late, comes in looking rushed, and leaves as quickly as possible. He often submits incomplete work when he does leave, but what he hands in is reasonable.

What would you suggest she do?



Case Study – Diversity challenges

Blake has runs an introduction to engineering course. He believes it's important for students to learn to work in diverse groups, so he decides the groups based on gender, marks and ethnicity. At the end of the project, Blake is horrified by the feedback. Many of the students hated the project and he realises that he has made many assumptions about the process.

What would you suggest he do?



Case Study - Pronouns count

Lindsey teaches a large undergraduate class. One day, he's taking questions and says, "Yes, the lady at the back in the blue shirt?"

The person responds, "I'm a 'he'."

Embarrassed, Lindsey says, "But you look like a girl."

The person blushes and Lindsey moves on to another student.

What would you suggest Lindsey do?



Case study - Invisible obstacles

Jacob is introducing his class to hands-on work in the workshop, so he organises a tour of the busy facility in groups. Part-way through the tour, he notices that one of his students is hanging further and further back, is mumbling to himself, and looks like he's counting on his fingers. Suddenly, the student turns around and dashes from the room, almost knocking over a workshop assistant in his rush. Later the student finds Jacob and explains that he is on the spectrum and that the workshop is a very difficult environment.

What would you suggest Jacob do?

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Wrap-up

- A question
- An insight
- A feeling

