

Fuzzy-Set Qualitative Comparative Analysis (QCA)

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Semi-structured Interview

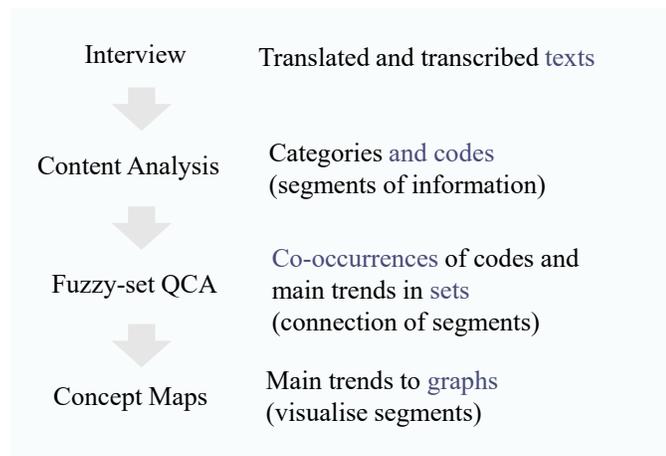


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Four groups of students ($n=38$)



- What are students' perceptions and experiences in this selective university?
- How could these influence their motivational and emotional experiences?



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Constructs

- ▶ Achievement motivation (Eccles et al., 1983; Elliot et al., 2011)
 - Controlled or autonomous motivation; achievement goals (i.e., self-/task-/other-based goals)
 - Expectancies (e.g., favourable outcome expectancy [favourable results], favourable action expectancy [favourable behaviours]) and values (e.g., interest, usefulness)
- ▶ Academic emotions (Pekrun, 2006; Peterson et al., 2015)
 - Positive, negative (e.g., fear, shame, anxious)
- ▶ Students' conceptions of assessment (Brown, 2011; Brown & Wang, 2016)
 - Accountability or external use, improvement and strategies (e.g., motivator, self-regulated learning), negativity, societal impact (e.g., competition and selection)

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Content Analysis

- ▶ systematic and flexible method that reduces qualitative information to smaller, manageable and meaningful forms of representation
- ▶ A deductive (or directed) orientation was firstly adopted to look for information coherent with the categories concerning conception, motivation and emotion presented in the literature;
- ▶ an inductive (or empirical) orientation was used for modification and addition to the a priori scheme to identify possible new ideas or relationships which emerged from the material (C. P. Smith, 2000).
- ▶ an initial codebook was developed on the basis of the expectancy-value models (e.g., Eccles et al., 1983) that define the expectancy and value components in richer ways and link to a broader array of psychological, social, and cultural determinants.

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Initial Codes

intercoder agreement was conducted to check the correspondence of code assignment between the researcher and an independent coder using the Kappa index. Four randomly selected interview transcripts representing a substantial proportion of the data (e.g., 10% to 20%) was double coded. The overall agreement between the two raters was $\kappa=.88$, which is deemed satisfactory.

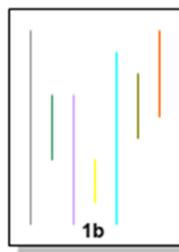
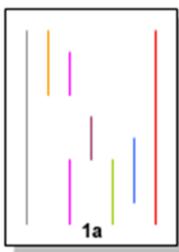
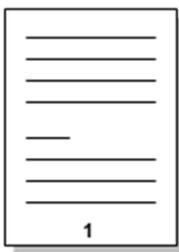
Categories and codes	Definition
<i>1. Achievement motivation</i>	
1.1 Controlled motivation	Extrinsic motivation that involves external regulation pertaining compliance or accountability, external rewards and punishments or introjected regulation pertaining self-control, ego-involvement, internal rewards and punishments.
1.2 Autonomous motivation	Autonomous motivation that involves mastery of knowledge, personal importance and conscious valuing.
1.3 Other-based goals	Attempts to do better or to avoid doing worse than others.
1.4 Self-based goals	Attempts do better or to avoid doing worse than before.
1.5 Task-based goals	Attempts to master or to avoid not mastering the requirements of the task.
<i>2. Expectancy-value</i>	
2.1 Expectancy of success	Students' beliefs about how well they will do on assessments. Sub-categories include whether the academic situation will produce positive/negative outcomes without any need for self-action or countermeasures (i.e., situation-outcome expectancy), whether students can successfully control their actions (i.e., action-control expectancy) and whether one's own actions will elicit certain positive outcome, or will prevent a negative outcome (i.e., action-outcome expectancy).
2.2 Subjective value	Students' own beliefs about academic activities, which are deemed as varied and subjective. Sub-categories include attainment value, cost, interest value and utility value.
<i>3. Assessment conceptions</i>	
3.1 Accountability	Assessment makes students accountable (i.e., student accountability) and is for grading, teachers' use or measuring school quality (i.e., school accountability).
3.2 Family effect	Assessment results have familial consequences on students.
3.3 Improvement and strategies	Assessment affects students' motivation, effort and the use of performance-enhancing strategies, and hard work is rewarded not just with societal selection but also with improvement, a sense of accomplishment, and positive reinforcement.
3.4 Negative aspects	Assessment produces negative emotions and evaluations, such as ignorance, irrelevance, negative emotions, or validity concerns.
3.5 Societal impact	Assessment has societal impacts, such as competition, legitimate selection, better careers, higher salaries; assessment is a lifelong experience.
<i>4. Academic emotions</i>	
4.1 Negative	Negative emotions around academic events, such as boredom, fear, anxiety, shame, guilt, depression and hopelessness.
4.2 Positive	Positive emotions (e.g., pride, enjoyment) around academic events.

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Software

- ▶ **Nvivo**: assign codes to texts; use "Code Stripes" to highlight code clusters and density
- ▶ **Excel**: record clusters with frequencies in cross-tabs

TEXT	CODES	CATEGORY
"Assessment is for grading and reporting. From the report, I will know how I am positioned among my peers and the gaps between better students and me. I'm afraid of being left behind. I don't want to perform worse than others so I work hard."	Grading & reporting	Conceptions of assessment [external use]
	Fear	Academic emotions [negative]
	Performance-avoidance	Achievement goals [other-based]



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Code



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Achievement motivation

Competence evaluation
Compliance
Curriculum demands
Effort cost
Emotional cost
Favourable learning behaviours/results
Making efforts
Reproduction
Self-based goals
Self-esteem
Task challenge
Other-based goals
Other learning skills
Unfavourable learning behaviours/results
Upward comparison
Usefulness

Assessment conceptions

Competition
Competitive comparisons
Gaokao/elimination
Grading and reporting
High-stakes consequences
Improvement
Legitimate external tool
Life-long
Monitoring and motivating
Questionable policies
Personal future
Sense of powerlessness

Academic emotions

Anxiety
Burden
Depressed
Fear
Pressured
Shame

Codes from main categories, sub-categories not shown

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Co-occurrences of codes



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(Schreier, 2012)

- Do some of the categories occur together?
- Do some of the categories occur near each other?
- Are some of the categories related in specific ways (e.g., an antecedent, a consequence, or an indicator of the other)?

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Set-theory in understanding co-occurrences

- ▶ The **interrelationships** between coded categories were reframed in terms of **sets**.
- ▶ For example, the main category of **academic emotions** can be viewed as a union of two subsets (i.e., positive emotions and negative emotions) and the co-occurrences of **performance-avoidance** goals and negative emotions can be seen as intersection of two sets.

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$$A = [1, 6]$$

$$B = [5, 10]$$

Intersection of set A and B:

$$A \cap B = 5, 6$$

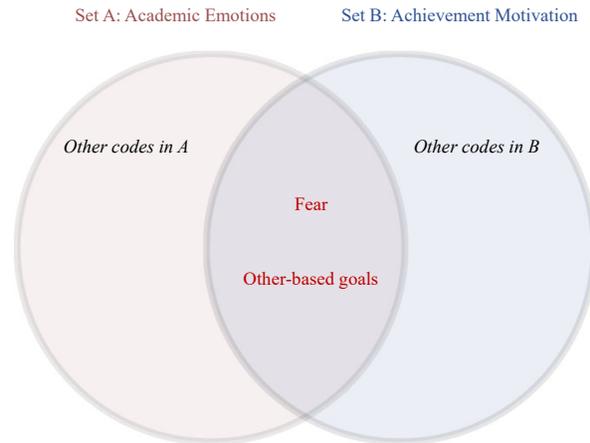


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“Assessment is for grading and reporting. From the report, I will know how I am positioned among my peers and the gaps between better students and me. I’m afraid of being left behind. I don’t want to perform worse than others so I work hard.”



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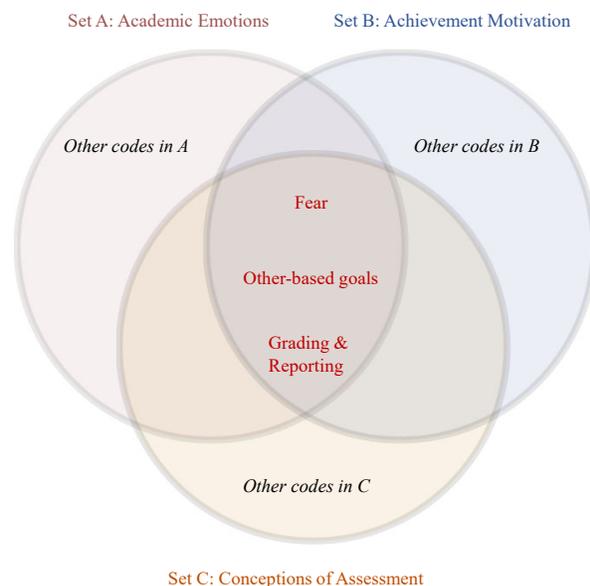


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Assessment is for grading and reporting. From the report, I will know how I am positioned among my peers and the gaps between better students and me. I’m afraid of being left behind. I don’t want to perform worse than others so I work hard.



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Fuzzy set



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But binary (in=1, out=0) classification may not suit research with humans. Hence, in *fuzzy set theory*, an object has a *degree of membership* in a set, a number between 0 and 1. For example, the degree of membership of a person in the set of "tall people" is more flexible than a simple yes or no answer and can be a real number such as 0.75.

A fuzzy set is a pair (U, m) where U is a set (often required to be *non-empty*) and $m: U \rightarrow [0, 1]$ a membership function. The reference set U (sometimes denoted by Ω or X) is called **universe of discourse**, and for each $x \in U$, the value $m(x)$ is called the **grade** of membership of x in (U, m) . The function $m = \mu_A$ is called the **membership function** of the fuzzy set $A = (U, m)$.

For a finite set $U = \{x_1, \dots, x_n\}$, the fuzzy set (U, m) is often denoted by $\{m(x_1)/x_1, \dots, m(x_n)/x_n\}$.

Let $x \in U$. Then x is called

- **not included** in the fuzzy set (U, m) if $m(x) = 0$ (no member),
- **fully included** if $m(x) = 1$ (full member),
- **partially included** if $0 < m(x) < 1$ (fuzzy member).^[5]

https://en.wikipedia.org/wiki/Fuzzy_set

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Fuzzy-set



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- ▶ Conventionally, a fuzzy set is scaled into $[0, 1]$.
 - “0” represents full non-membership in a set (i.e., fully out of the set)
 - “1” indicates full membership
 - the 0.5 score is considered as a **maximum ambiguity**, or crossover point in the evaluation of whether a case belongs to a set.
- ▶ a six-value scheme (Ragin, 2008) was developed to assign graded membership in between **the qualitative anchors**
 - (i.e., 0=full non-membership, 0.2=mostly out, 0.4=more out than in, 0.6=more in than out, 0.8=mostly in, 1=full membership).

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How to do it?



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Four Steps

- 1) Identifying conditions (i.e., **comparable co-occurrences**)
- 2) Calibrating fuzzy sets and establishing degrees of set membership
- 3) Converting data and assigning fuzzy-set values
- 4) Presenting the results

Basurto, X., & Speer, J. (2012). Structuring the Calibration of Qualitative Data as Sets for Qualitative Comparative Analysis (QCA). *Field Methods*, 24(2), 155-174.

<https://doi.org/10.1177/1525822x11433998>

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Precision depends



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- ▶ the degree of precision of our fuzzy sets based on the level of detail in our qualitative data. Our data lent themselves to a four-value fuzzy set a fuzzy set with the values:
 - “Fully out [0],”
 - “more out than in [0.33],”
 - “more in than out [0.67],” and
 - “fully in [1]” Basurto & Speer 2012

The table below shows how the four fuzzy-set values were defined for two of the measures of effective participator governance.

Condition	Measures	Fuzzy-Set Value Definitions
Effective Participatory Governance (EPG)	Participation of all required groups of actors	0: None of the required groups participates 0.33: Less than half the organizations participates 0.67: Half or more of the organizations participate 1: All the required groups participate
	Provision of information from Municipal Corporation to Municipal Development Council about municipal revenues and expenses	0: No revenues and expenses are communicated once a year 0.33: All revenues and expenses are communicated once a year 0.67: All revenues and expenses are communicated twice a year 1: All revenues and expenses are communicated three or four times a year

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Fuzzy-set calibration



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Identify conditions of comparable co-occurrences and determine the fuzzy-set values for calibration

Conditions (Comparable co-occurrences)	Sub-dimensions	Co-occurrence indicators and definition	Fuzzy-set values and calibration	
Achievement goals & assessment conceptions/experience	Self-based evaluation of competence	Indications of pursuit of achievement goals by using self-based evaluation of competence, either for achieving success or avoiding failure. Co-occurrences: Self-based Achievement Goals (SAG), Attainment values and/or Motivation and Self-regulated Learning (SRL) in SCoA	0	None of the indicators were met.
			0.2	Up to two students indicated using self-based goals.
			0.4	At least two but less than half of the students indicated using self-based goals.
			0.6	More than half but less than 80% of the students indicated using self-based goals.
			0.8	More than 80% but not all students indicated using self-based goals.
	1	All students indicated using self-based goals.		
	Performance/other-based evaluation of competence	Indications of pursuit of achievement goals by using performance-/other-based evaluation of competence, either for achieving success or avoiding failure. Co-occurrences: Performance-/other-based Achievement Goals (PAG), Competence Evaluation (via upward comparison) and/or Societal Impacts in SCoA	0	None of the indicators were met.
			0.2	Up to two students indicated using performance-/other-based goals.
			0.4	At least two but less than half of the students indicated using performance-/other-based goals.
			0.6	More than half but less than 80% of the students indicated using performance-/other-based goals.
0.8			More than 80% but not all students indicated using performance-/other-based goals.	
1	All students indicated using performance-/other-based goals.			

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Fuzzy-set calibration

Fuzzy-membership Scores for Identified Conditions

Condition & Sub-Dimension	Group			
	Elite	Ordinary	Up	Down
<i>Achievement Goals</i>				
Self-based evaluation of competence	0.6	0.8	0.8	0.2
Performance-/other-based evaluation of competence	0.8	0.6	1	0.8
<i>Controlled Motivation</i>				
Introjected regulation	0.8	0.6	1	0.2
External regulation	1	0.6	0.8	0.8
<i>Subjective Control</i>				
Internal Control	0.6	0.4	0.8	0
External Control	0.8	0.6	0.4	0.8
Internal Attributions	0.8	0.8	1	0.8
External Attributions	0.8	0.8	0.4	1
<i>Subjective Values</i>				
Intrinsic	0.6	0.4	0.8	0.2
Extrinsic	0.6	1	0.8	0.4
<i>Academic Emotions</i>				
Positive	0.6	0.6	0.6	0.2
Negative	1	0.8	0.6	1

Note. "Mostly-in" (i.e., "0.8") and full membership (i.e., "1") are in **boldface**.

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Truth Table for Students' Perceived Assessment Experience in Identified Conditions by Group

Truth Table

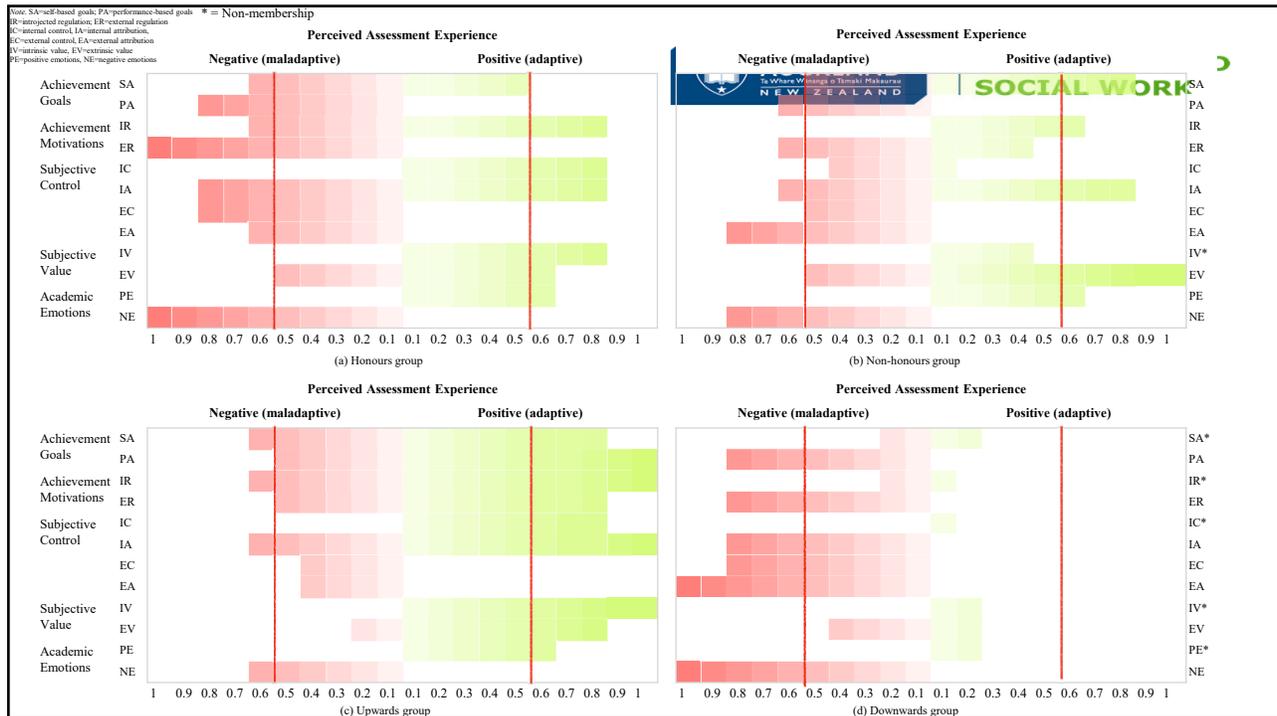
Simplification especially because cell sizes were small. We were looking for dominant ideas within each group

0.8 and above = 1
Else = 0

Condition & Sub-dimension	Assessment Experience by Group							
	Negative				Positive			
	Honours	Ordinary	Up	Down	Honours	Ordinary	Up	Down
<i>Achievement goals</i>								
Self-based goals	1	0	1	—	1	1	1	—
Performance-/other-based goals	1	1	0	1	0	0	1	0
<i>Controlled motivation</i>								
Introjected regulation	1	0	1	—	1	1	1	—
External regulation	1	1	0	1	0	0	1	0
<i>Subjective control</i>								
Internal control	0	0	0	—	1	—	1	—
Internal attributions	1	1	1	1	1	1	1	0
External control	1	1	0	1	0	0	—	0
External attributions	1	1	0	1	0	0	—	0
<i>Subjective values</i>								
Intrinsic values	0	—	0	—	1	—	1	—
Extrinsic values	1	1	1	—	1	1	1	—
<i>Academic emotions</i>								
Positive	0	0	0	—	1	1	1	—
Negative	1	1	1	1	0	0	0	0

Note. "0" = Absence of students' conceptions of assessment linking with the identified conditions; "1" = Presence of students' conceptions of assessment linking with the identified conditions; "—" = Non-membership in identified conditions.

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Visualise the results

- ▶ Memberships demonstrate the results in a **parsimonious way** and show the **general tendency** of clustering codes
- ▶ It's necessary to “decode” and manifest the abstract information

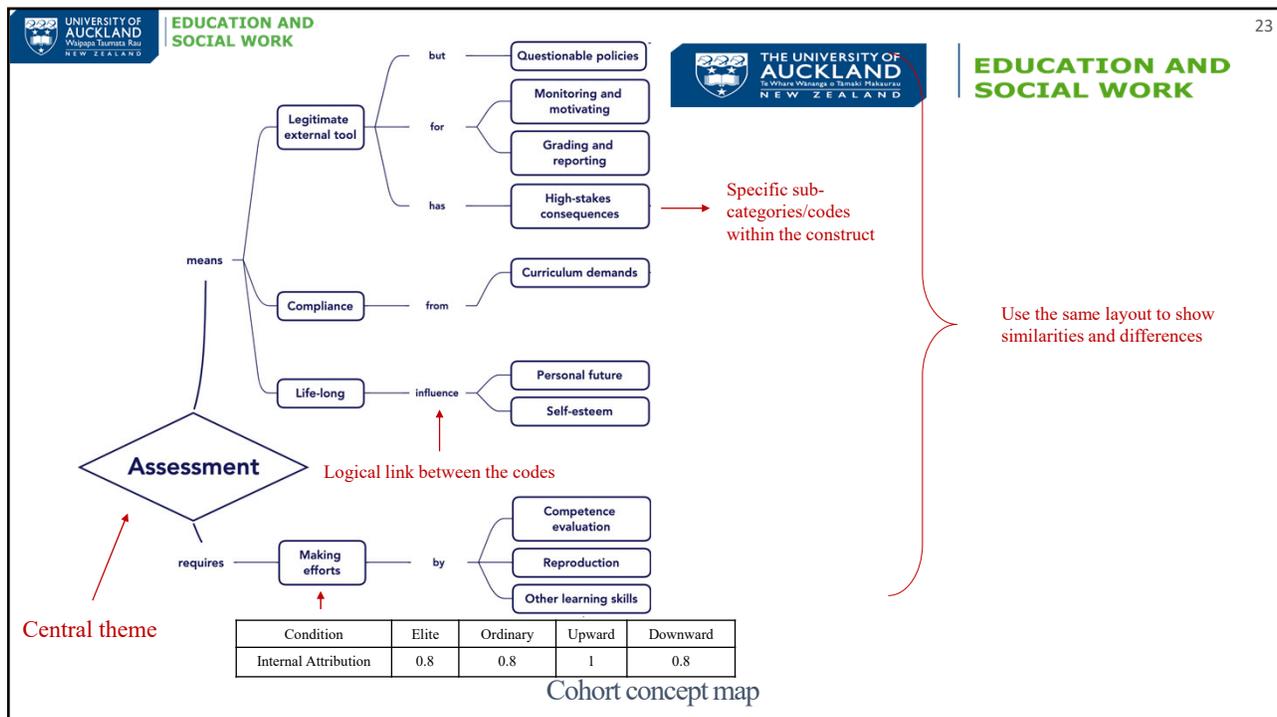
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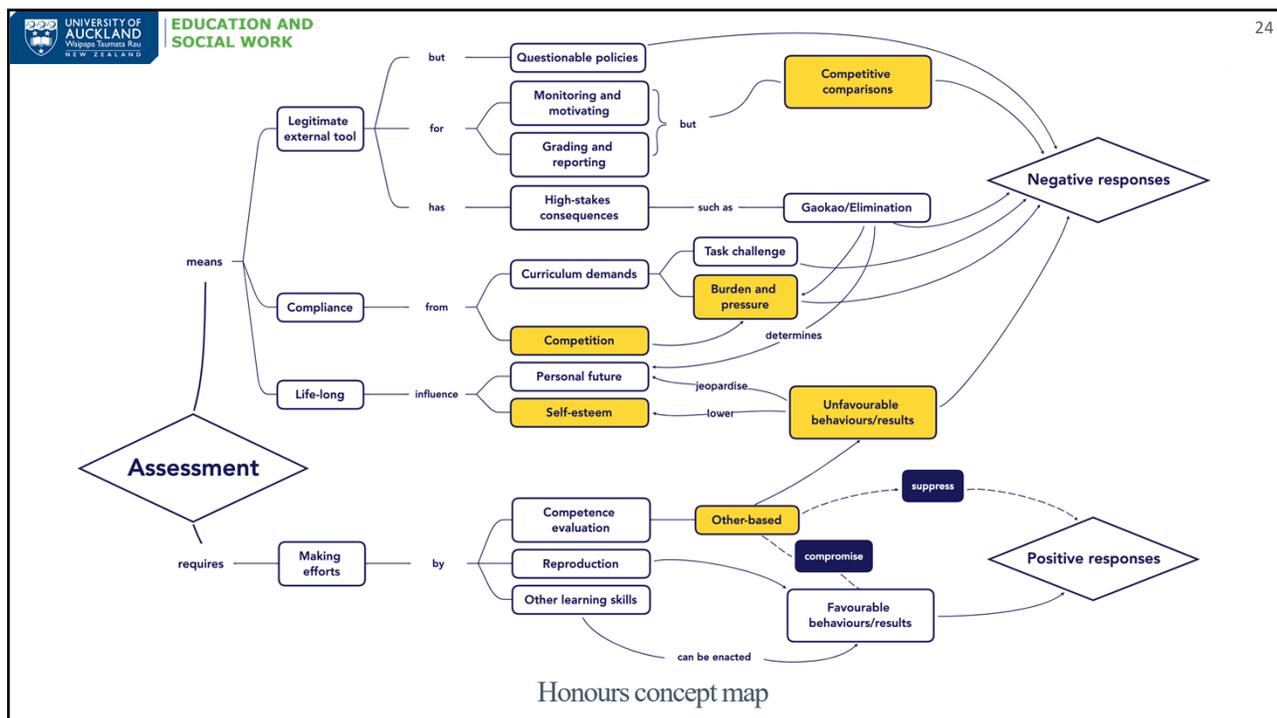
Visualise the results

- ▶ Focus on significant memberships (i.e., fuzzy-set values ≥ 0.6)
- ▶ Place the central theme (i.e., assessment experience; research question 1)
- ▶ Examine the logical links between co-occurrences (e.g., because, cause, conflicting) with the central theme and relevant codes (research question 2)
- ▶ Arrange the co-occurrences by using software (e.g., XMind, MindNode)

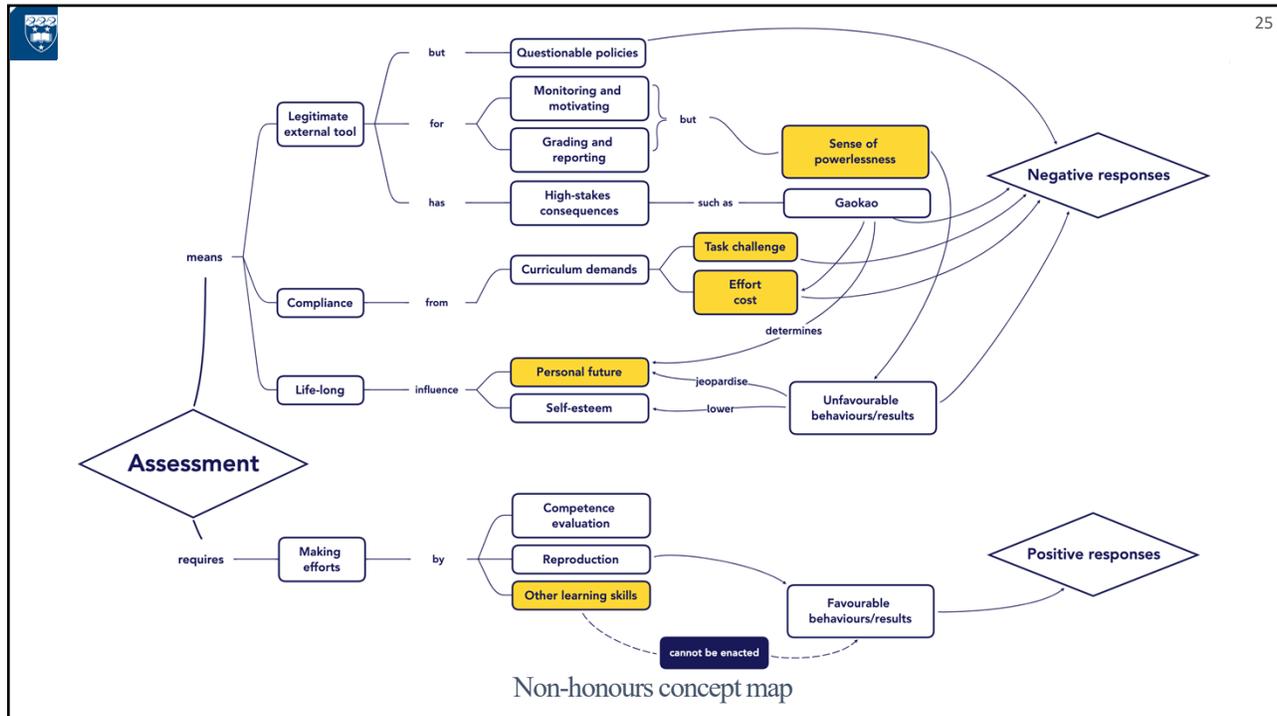
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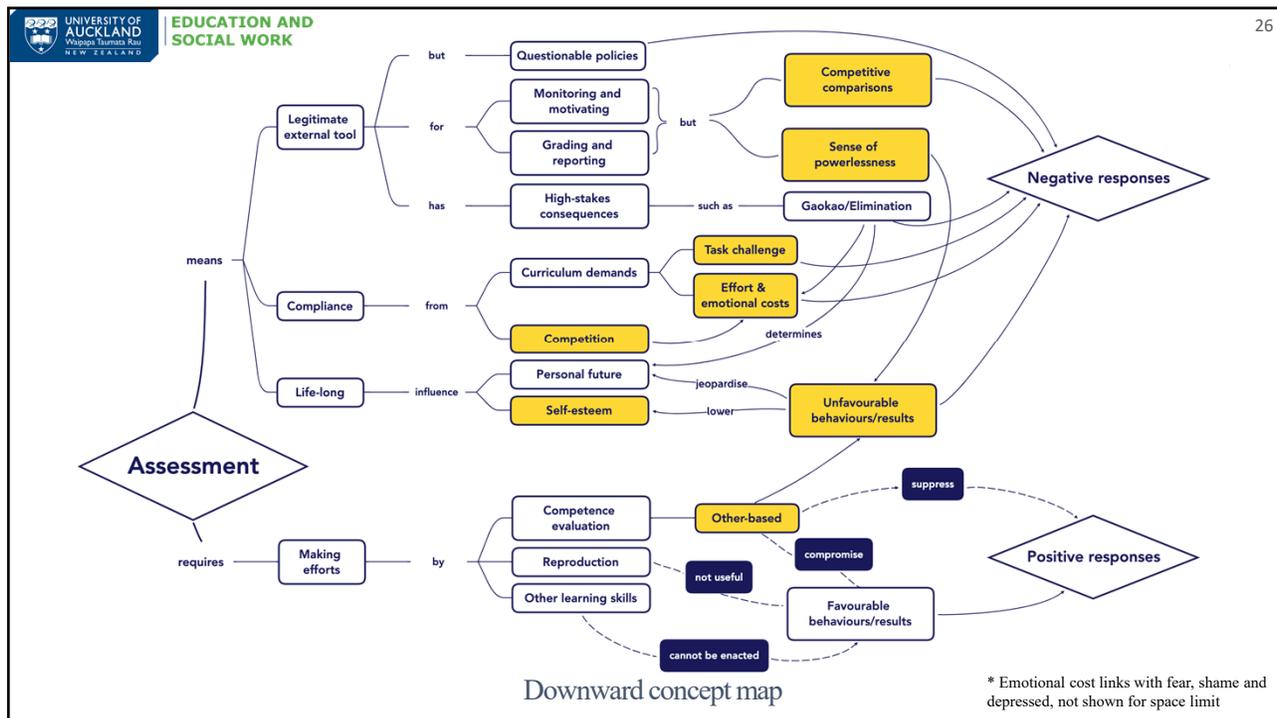
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