Leveraging data science to analyze and interpret qualitative data from student evaluations of teaching

Bluenotes Global
Louisville, KY

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Meet the team!

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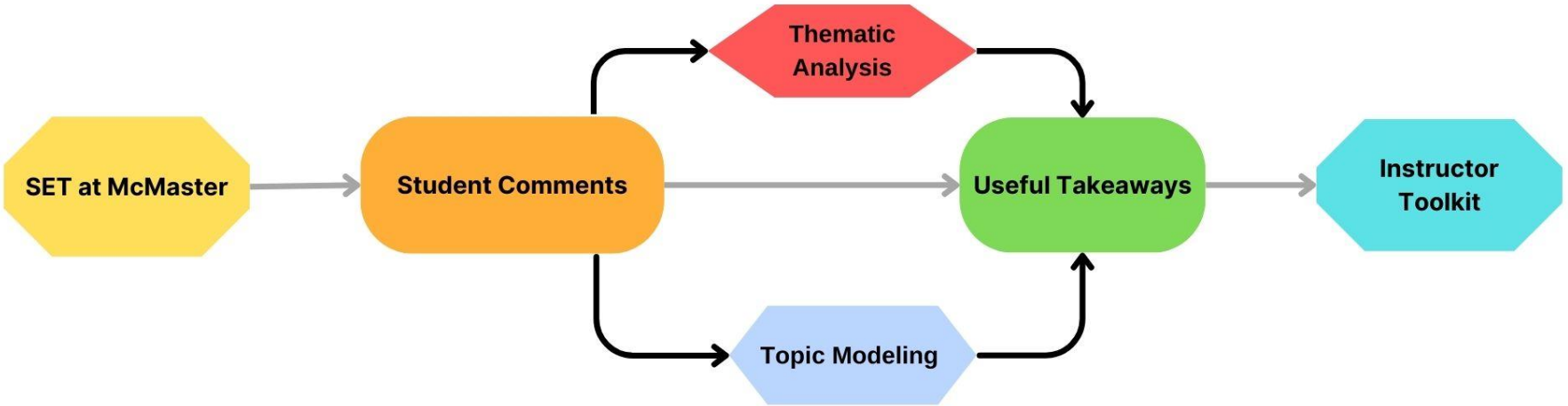
(student partner)

Sharonna Greenberg
(Chemistry & Chemical Biology)

Amanda Kelly Ferguson
(MacPherson Institute)

Rashmi Panse
(student partner)

Overview


Thematic Analysis
SET at McMaster
Student Comments
Useful Takeaways
Instructor Toolkit
Topic Modeling

Creating a **BRIGHTER WORLD**

"R1 institution"

*Times Higher Education and Shanghai Jiao Tong University Ranking
**Re$earch Infosource Inc. 2019
***Times Higher Education in partnership with Vertigo Ventures based on United Nations Sustainable Development Goals


McMaster University
Based in Hamilton, the third largest city in Ontario
Toronto
45 minutes
Ottawa
5 hours
OTTAWA
New York City
1 hour
TORONTO
McMASTER UNIVERSITY
BOSTON
CHICAGO
NEW YORK CITY
Boston
1.5 hours
Louisville!
Chicago
1.75 hours

McMaster University

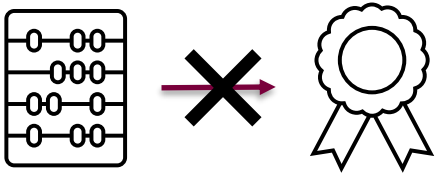
We recognize and acknowledge that students of McMaster University meet and learn on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "Dish With One Spoon" wampum, an agreement to peaceably share and care for the resources around the Great Lakes.

Student evaluations of teaching at McMaster

SET at McMaster

Biased against women and minorities

Quantitative “overall” score is not valid to measure teaching effectiveness



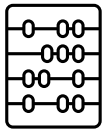
Students are disillusioned

Lack of trust among instructors

(Gravestock & Gregor-Greenleaf, 2008; Ryerson desigion., 2018; Grignon et al., 2019)

Reexamining SETs at McMaster and across Canada

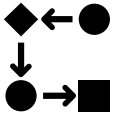
SET at McMaster



- Revise quantitative “overall” question
  - “Effectiveness of instructor” → “Learning experience”

- Consider formative rather than summative evaluation

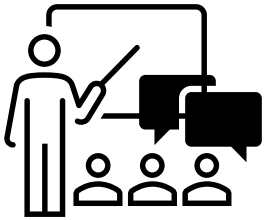
- Create an institutional definition for teaching effectiveness



- Change processes and policies

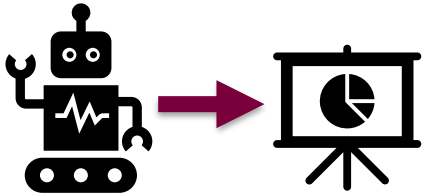
Context & Rationale

Leveraging data science to analyze & interpret qualitative data



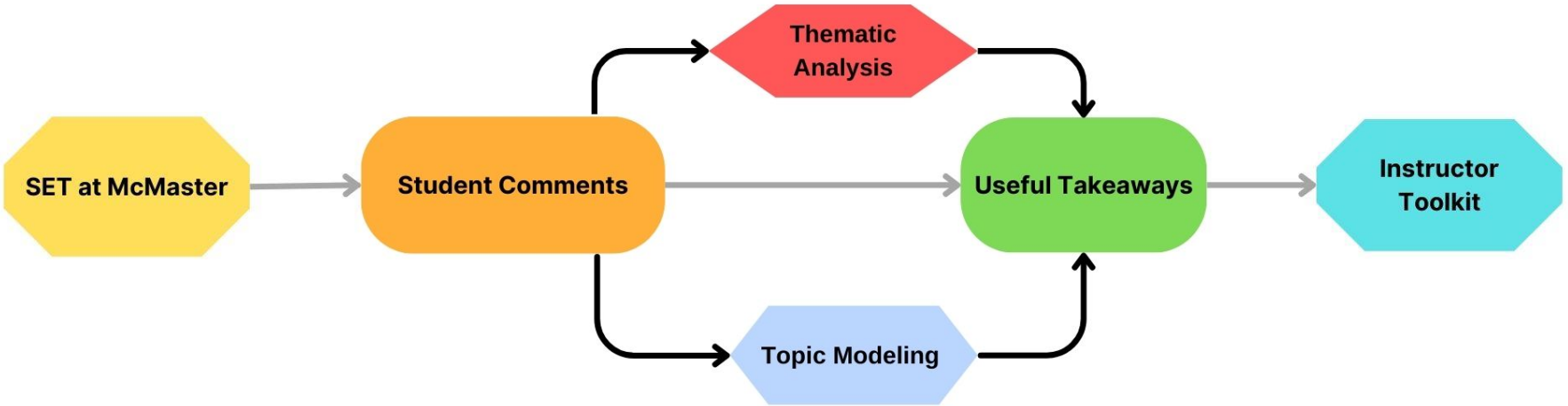
- Student comments provide rich and contextualized information

- Interpreting qualitative data is challenging



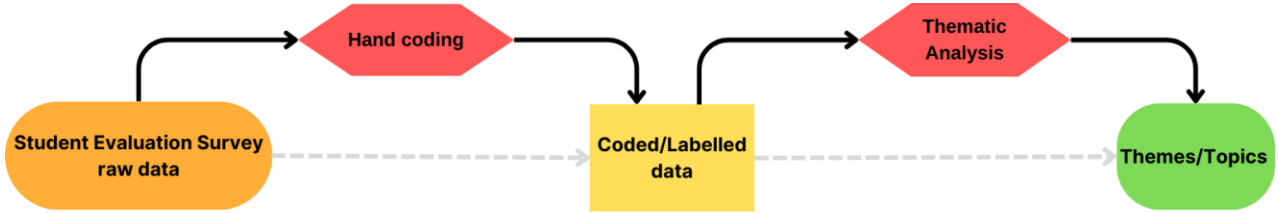
- Our tool will use **natural language processing** and **machine learning** to provide **semi-automated** analysis

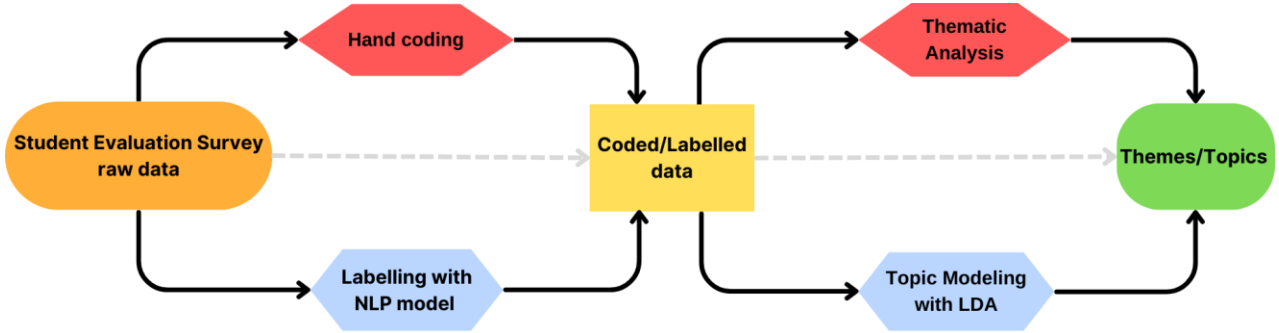
Methods for qualitative analysis



Workflow

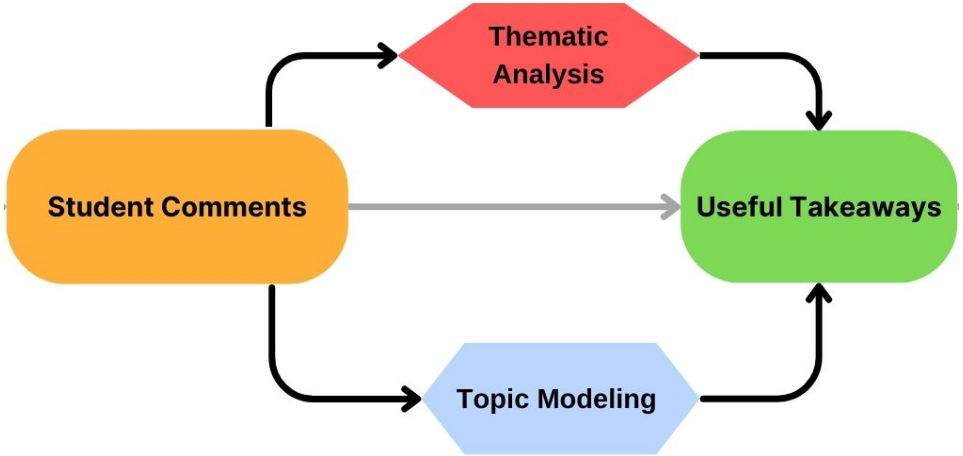

Student Evaluation Survey raw data
Coded/Labelled data
Themes/Topics


Hand coding
Thematic Analysis
Student Evaluation Survey raw data
Coded/Labelled data
Themes/Topics


Hand coding
Thematic Analysis
Student Evaluation Survey raw data
Coded/Labelled data
Themes/Topics
Labelling with NLP model
Topic Modeling with LDA

Thematic Analysis vs Topic Modelling

Terminology



	Thematic Analysis	Topic Modelling
	Comment	Document
	Code	Label
	Theme	Topic

Data sets for case study

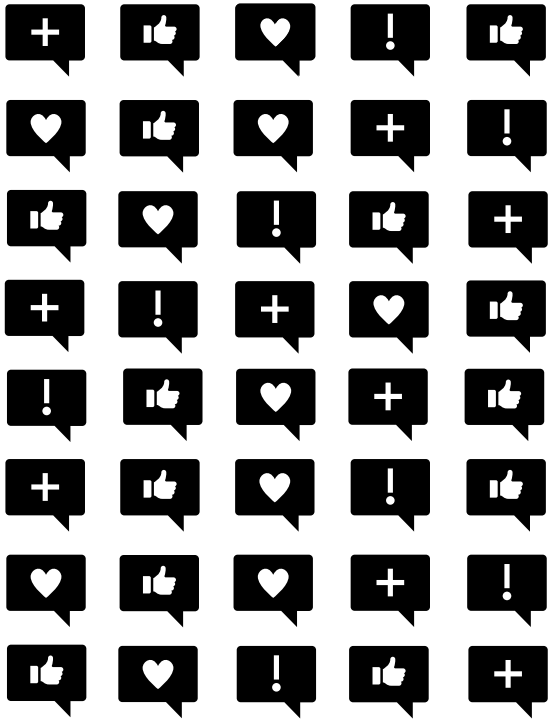
Student Comments

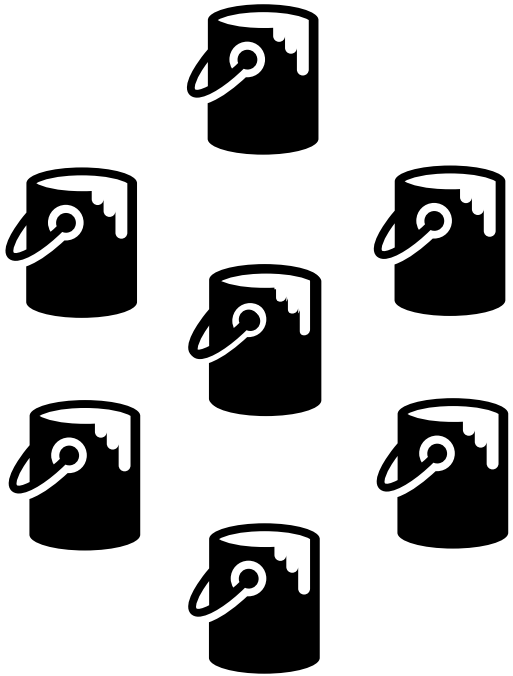
- 3 large-enrollment freshman (first-year) chemistry courses during COVID-19
- ~1500 responses in each data set

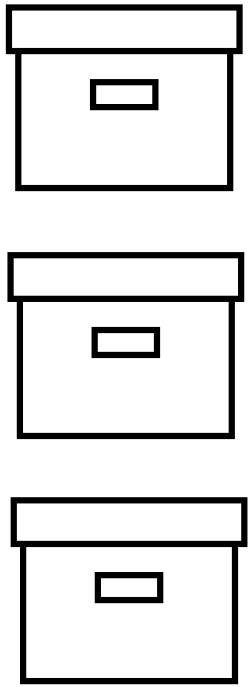
- Rank the resources in this class from most useful to least useful (quantitative)
- What is working well in this course? (qualitative)
- What suggestions do you have for this course? (qualitative)

Braun & Clarke, 2008; Creswell, 2013

Thematic Analysis







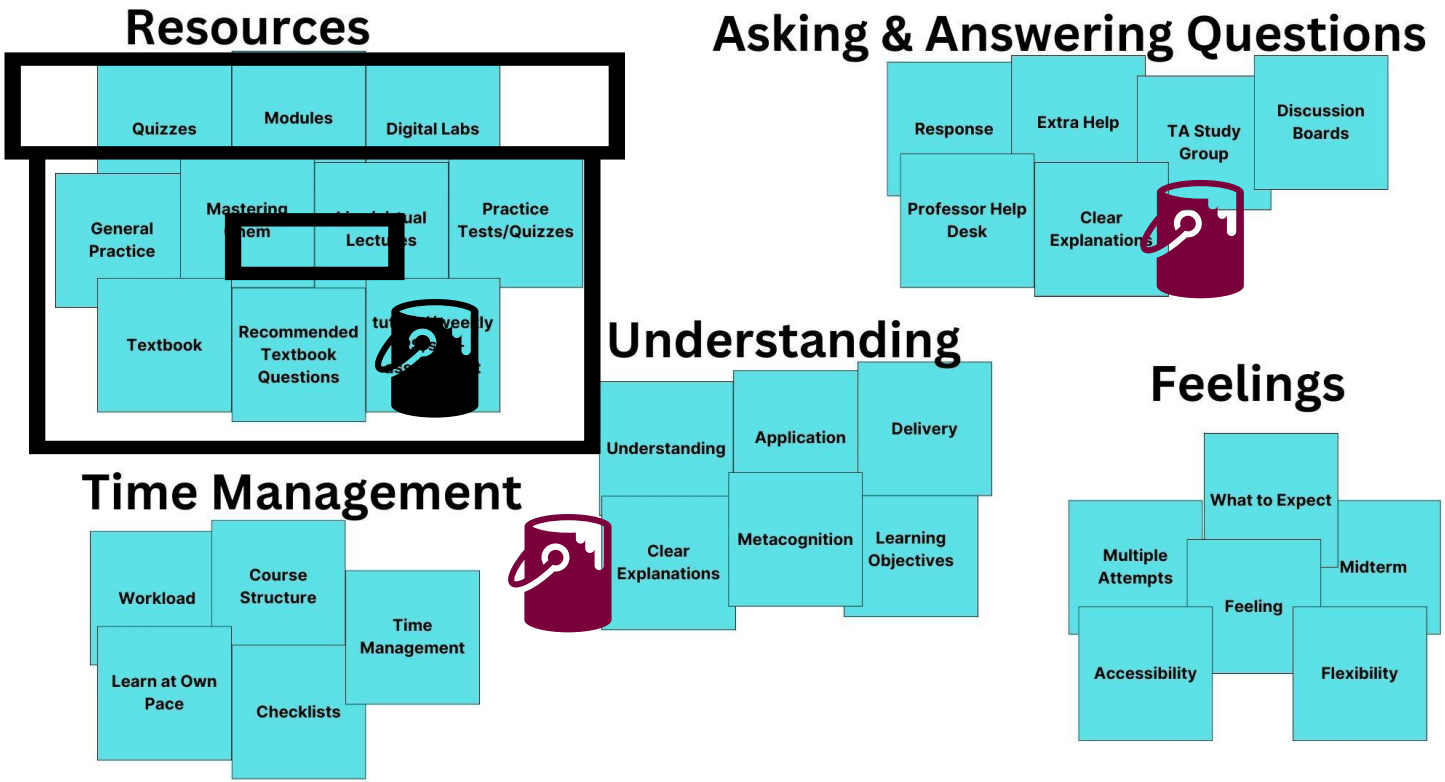
Sample qualitative coding

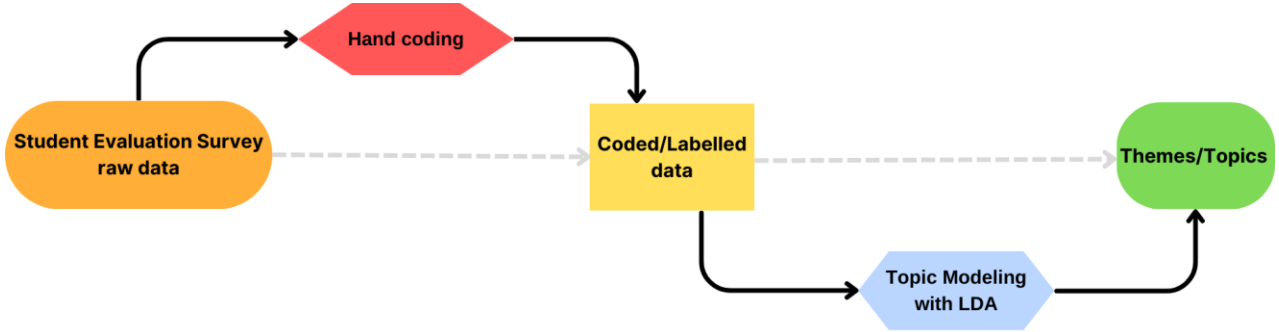
Thematic Analysis

ID	What is working well?	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
151	The live lectures explain the content more thoroughly than the modules. The professor answers the Q&A during the lecture. There is a lot of practice material. The weekly checklists are helpful. I like that the quizzes and labs are unlimited time so we can work on them throughout the week. The professor help desk is very helpful.				1		1									1			1	1											1		
152	I like to work through the problems that are in the problem-solving modules. I also like that the lectures are pre-recorded so that I can watch them as many times as needed to understand a concept.			1										1				1								1						
153	Practicing questions on the practice quiz that are similar to those on the actual quiz and tests.										1																		1			
154	Being given learning goals/expectations											1																					
155	The quizzes are helpful to give me an estimate of my understanding for a particular topic.									1								1															1
156	The practice courses																																
157	I really like that the pre recorded videos are given as short and manageable amounts of information (rather than 1 long video, 4 smaller videos).			1																				1									
158	Practice tests, self-assesments							1			1																						
159	Currently not much is working well for me, but that is my own fault because I am not putting enough effort into the class.																																

Sample thematic map

Thematic Analysis



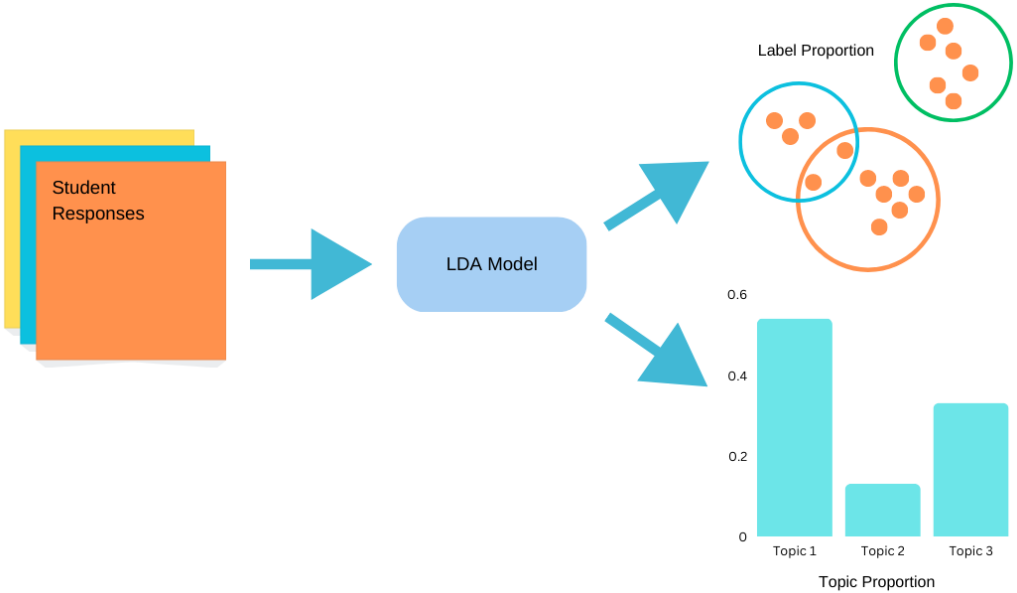

Hand coding
Student Evaluation Survey raw data
Coded/Labelled data
Themes/Topics
Topic Modeling with LDA

Topic Model

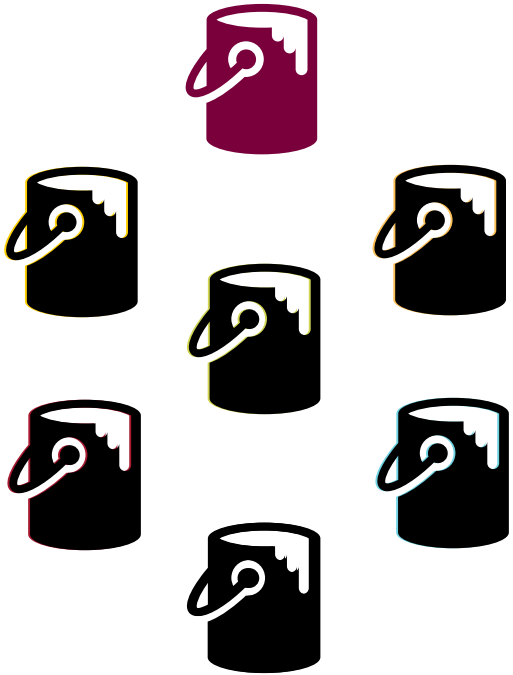
- Topic Modeling is a way to identify the abstract topics that occur in a collection of documents.
- Topic Modeling is like a smart highlighter identifying keywords and phrases within these comments. It then groups these words into topics, helping us understand the main themes these comments are talking about.

Latent Dirichlet Allocation (LDA)

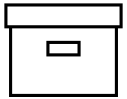
- Latent Dirichlet Allocation (LDA) is a generative model widely used for topic modelling. It represents comments as mixtures of topics that produce words based on their probability distribution.
- Labels Proportion associates the labels with different topics
- Topic Proportion shows the mixture of topics for a given comment
- The number of topics in LDA is a hyperparameter and needs to be pre-determined



Topic Modelling

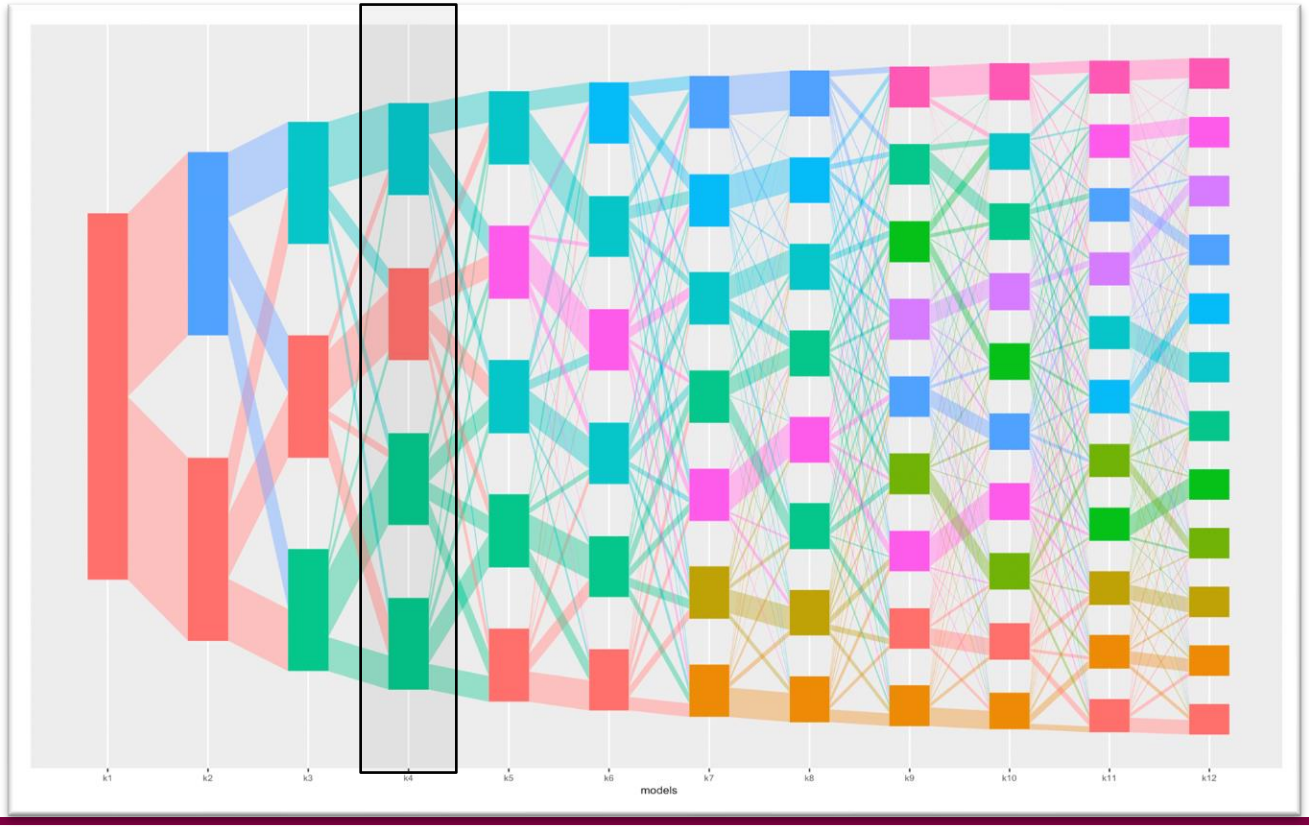


label

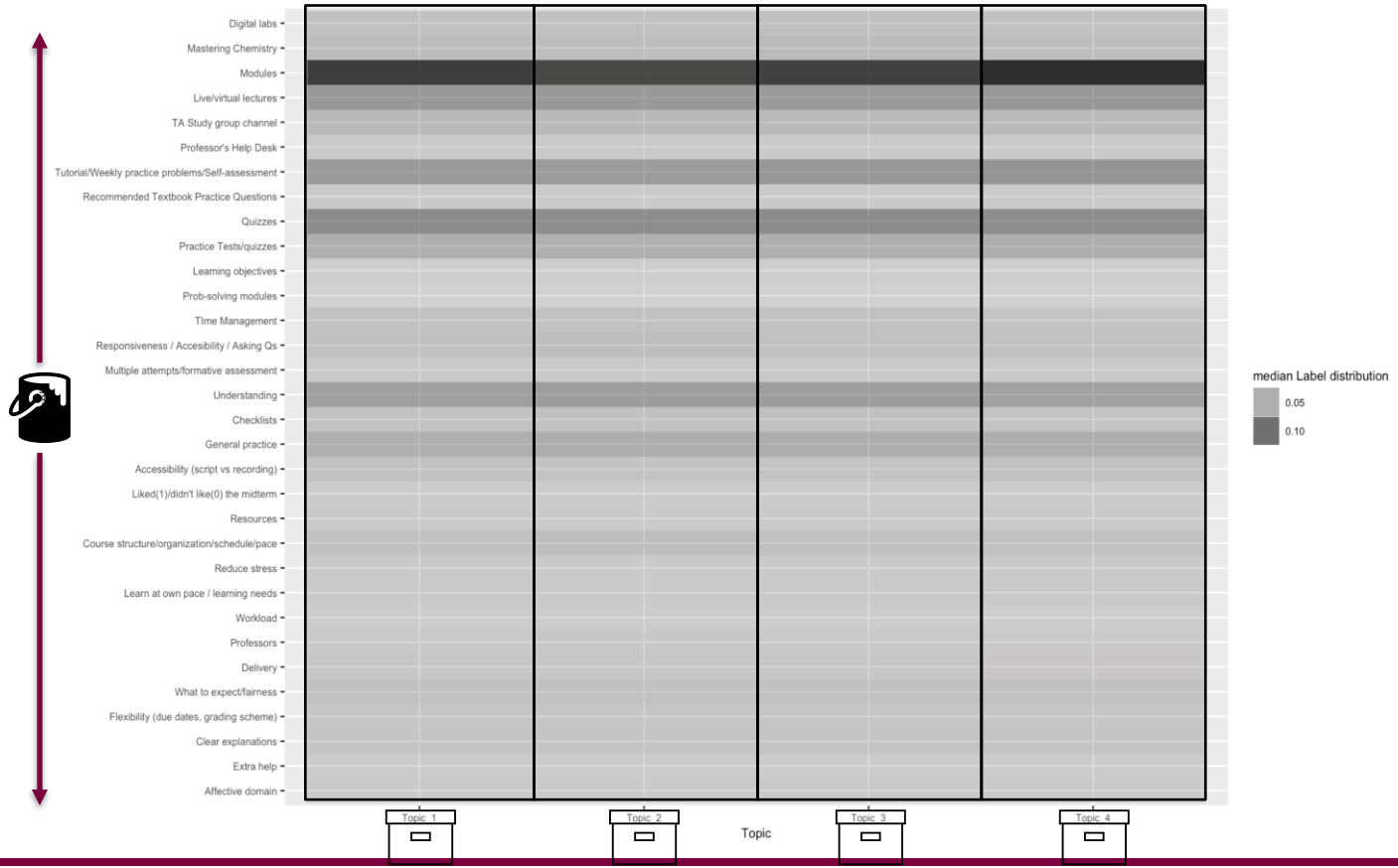


topic

Determine the number of topics



Label Distributions

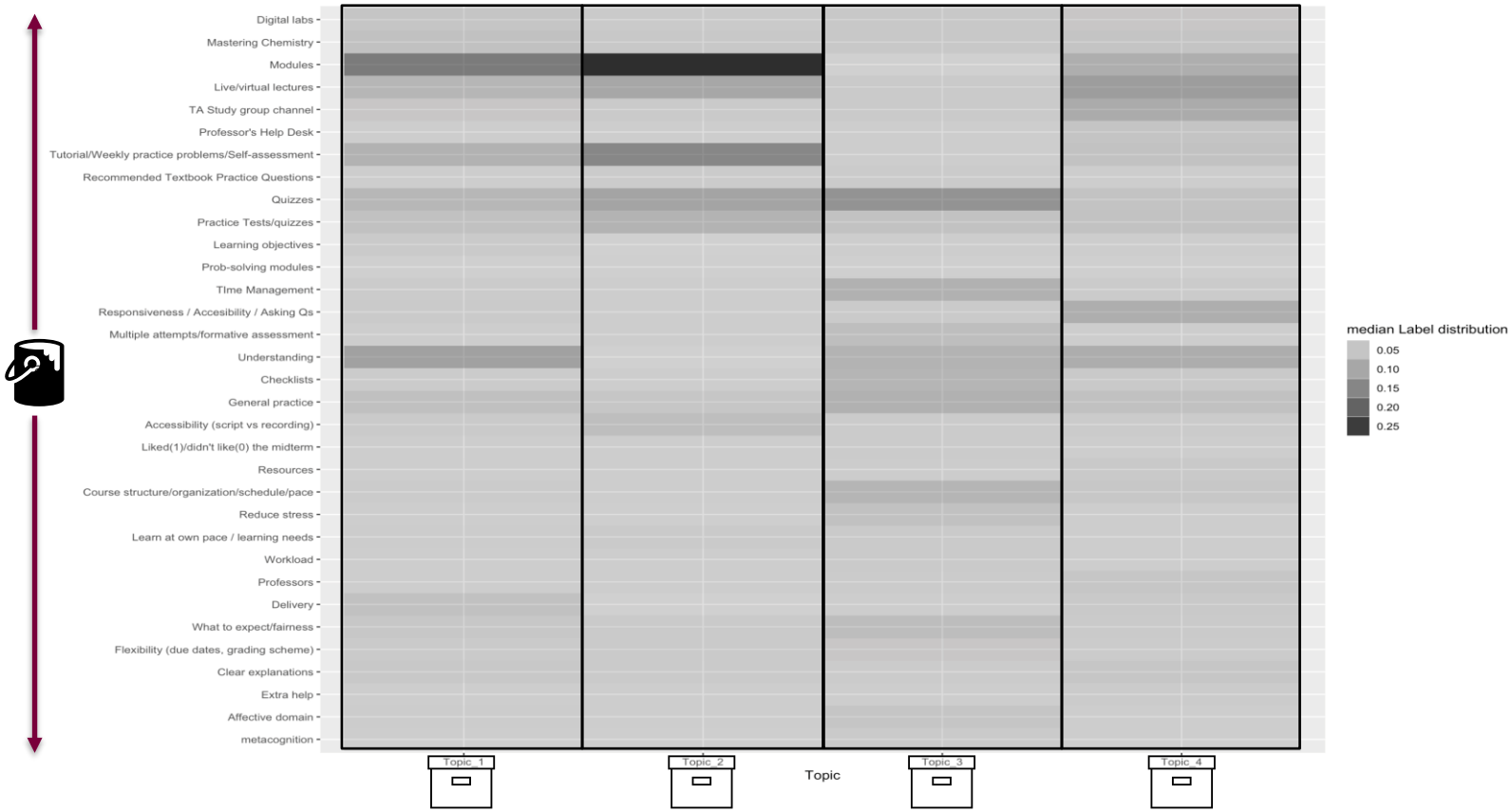


Problems:

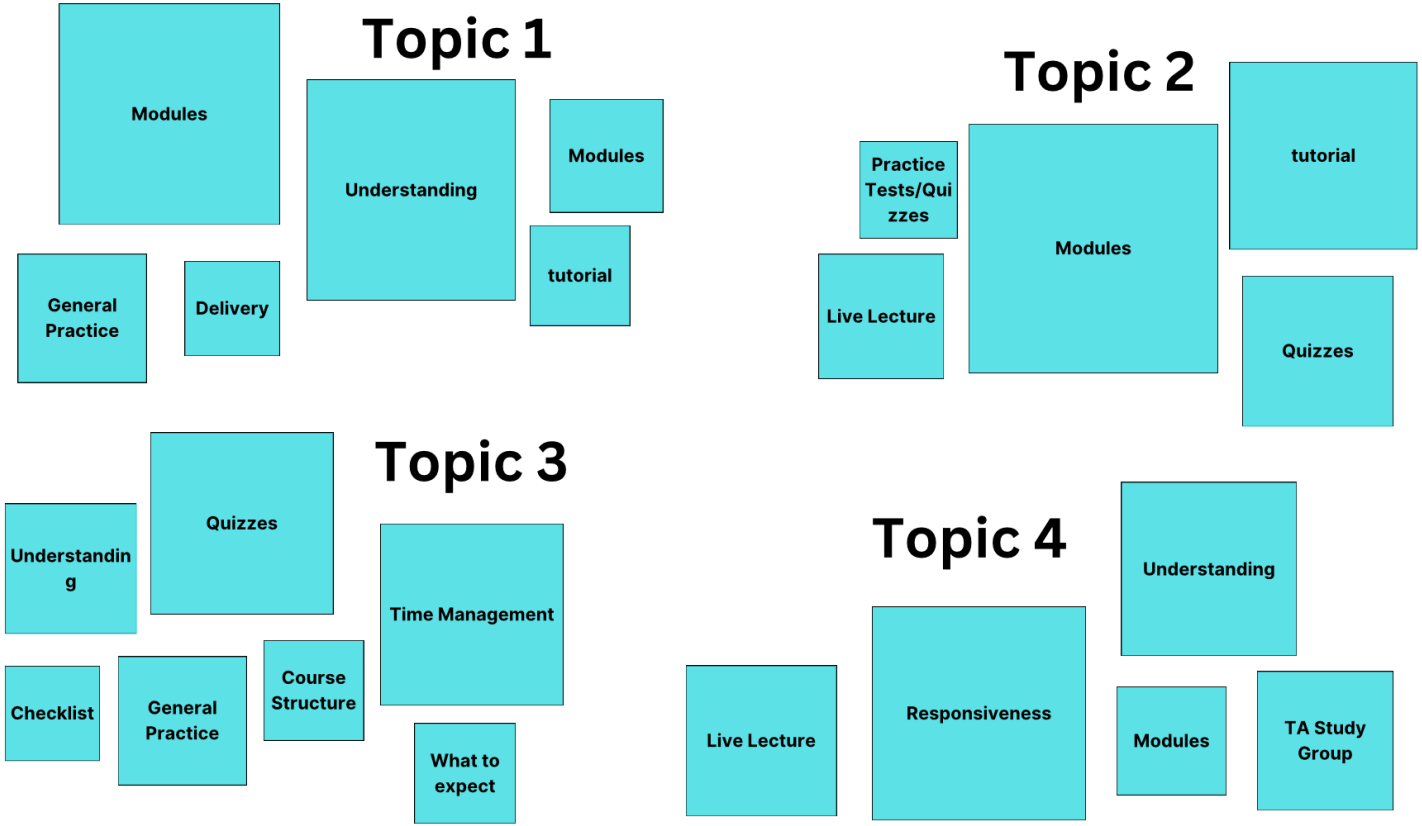
Similar label distribution

Uneven distribution of the labels in the dataset

Label distribution with different hyperparameters

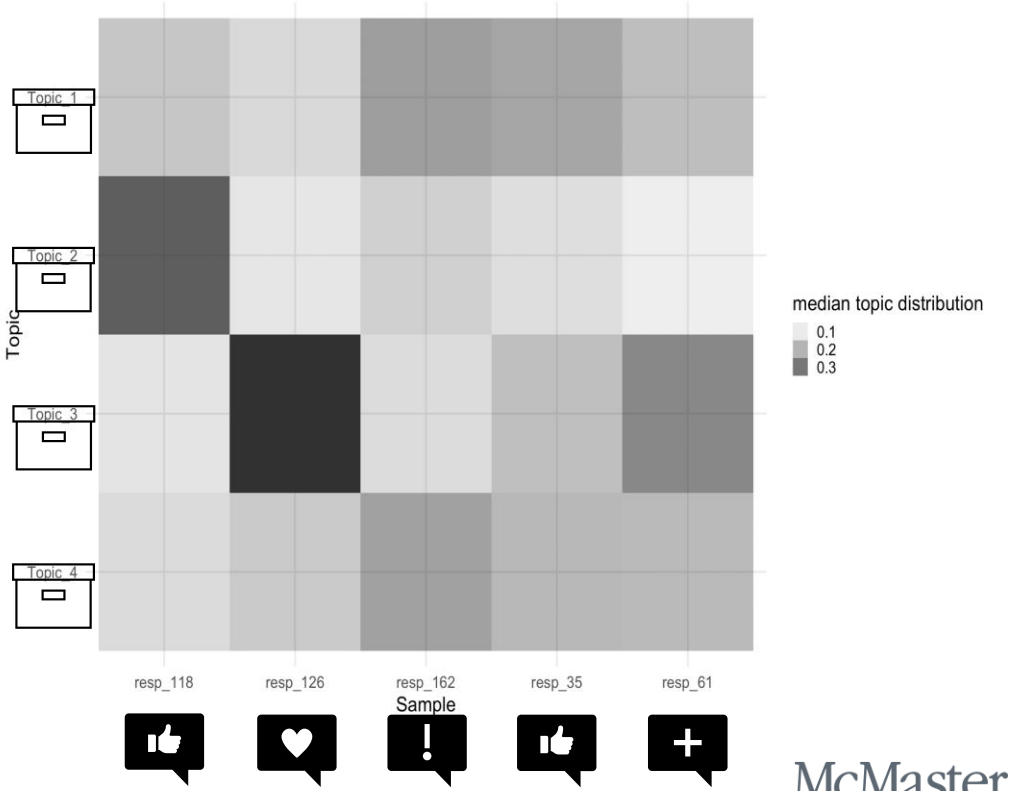


Sample topic modelling map



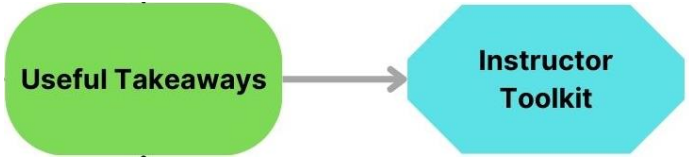
Topic Distribution

- Response 126: I find the practice tests (unlimited tries) are very beneficial along with the weekly quizzes. Both of these awesome practice questions and make sure I stay caught up.
- Response 162: Having readily accessible content to which I can refer to when I am struggling in a particular topic in the course.

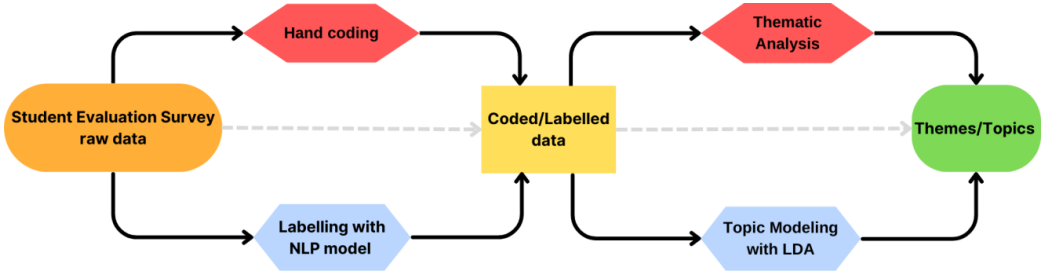



'An astonishing comic writer'
NEIL GAIMAN
42
ANNIVERSARY EDITION
THE HITCH-HIKERS GUIDE TO THE GALAXY
DOUGLAS ADAMS
ILLUSTRATED BY
CHRIS RIDDELL

Next Steps



- Interpret the resulting label distribution
- Utilizing existing Natural Language Processing(NLP) models to extract the codes/labels from the student comments to replace the hand-coding process
- Expand the same tool to different courses



Why not ChatGPT?

01

Privacy

02

Deeper Understanding

03

Interpretation

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Office of the Provost & Vice-President (Academic)

Academic Excellence

Manual coding – thematic analysis

Inductive	Deductive
Top-down, analyst-driven	Bottom-up, data-driven
Prescribed codes => class resources	Emergent codes => participant responses (time management, responsiveness, understanding)
Data fits within codes	Codes fit with data