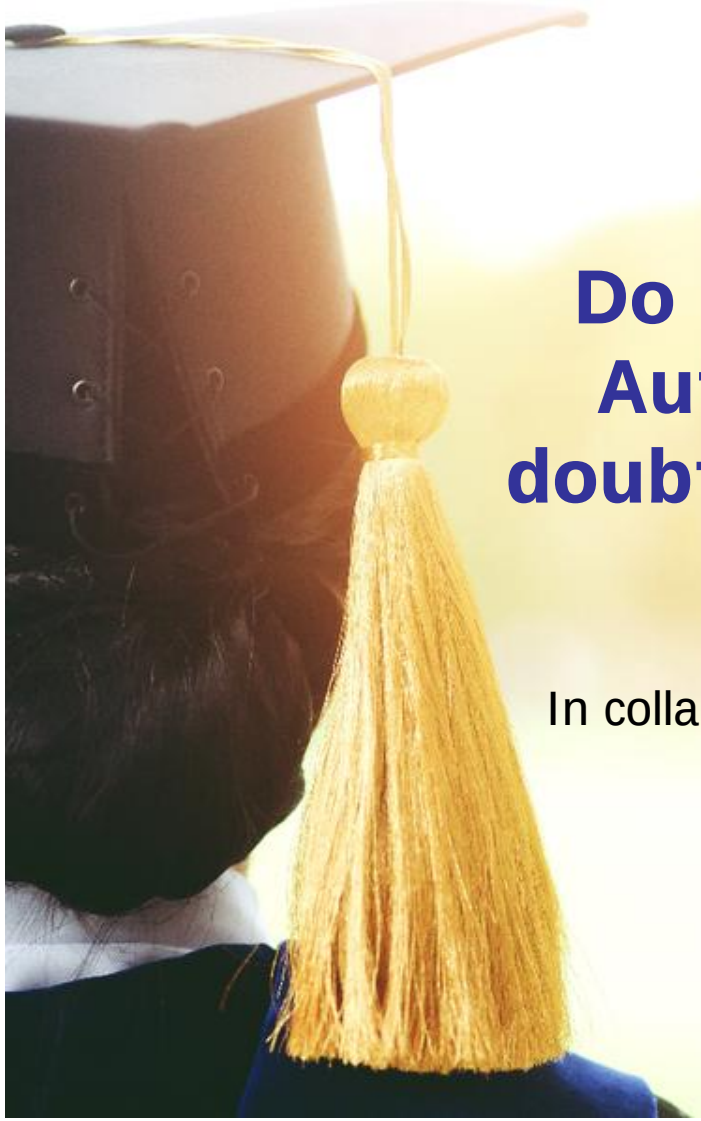
School of
Information Systems

SMU
SINGAPORE MANAGEMENT UNIVERSITY



Do my students understand? Automated identification of doubts from informal reflections

Presented by Dr. Kar Way TAN

In collaboration with Dr. Siaw Ling LO & Dr. Eng Lieh OUH

School of Information Systems,

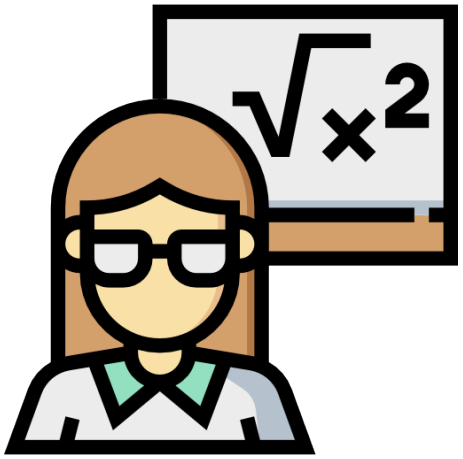
Singapore Management University

27th February 2020

The learner-centered pedagogy allows learners to learn at different pace

From One-Way instruction to Learner-Centred

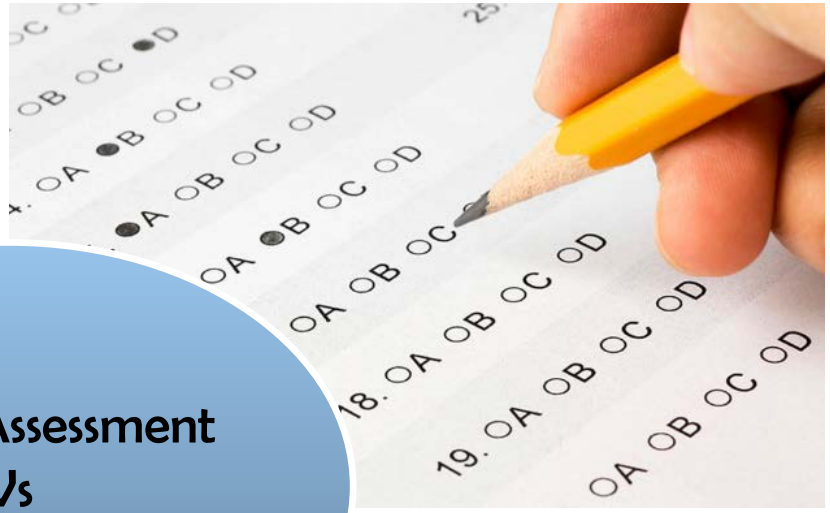
“Every learner is unique”



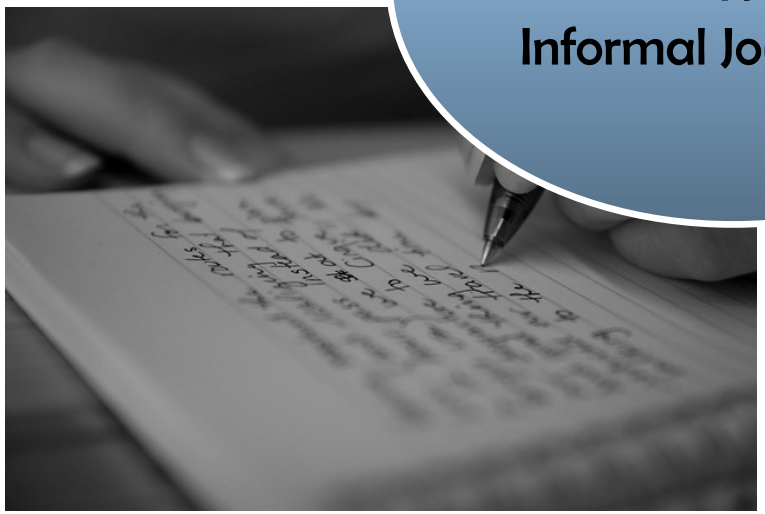
Timely
&
relevant guidance

specific to needs of each learner

Do my students understand?



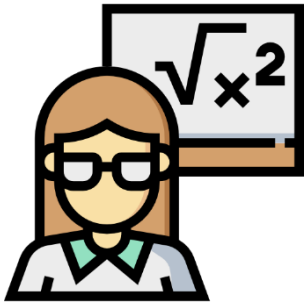
Formal Assessment
Vs
Informal Journaling



Weekly reflection was introduced to a foundation class

- The course: Analytics Foundation
  - Undergraduate level taken by students from various disciplines – *business, social science, information systems*
  - Total of 13 sessions of seminar-style learning environment with about 45 students in each class, over 3 hours of class engagement per week
  - Examples of topics include visualization, classification, linear regression, clustering and rule mining.
- Two course instructors collected weekly reflections as part of students' learning journey.

The reflection questions are non-intimidating



Instructor 1
Free-form text for entering key take-away.
Likert Scale 1. Totally lost – need a consultation 2. Somewhat lost – will catchup on my own 3. Not applicable – I was not in class for a valid reason 4. Understood many parts 5. Understood almost fully

Instructor 2
Free-form text for entering key take-away or constructive feedback to improve learning.

We observed interesting reflections …

- Statements with "wisdom":
  - "I have learnt about the systematic steps during data preparation phase. The situations where we should use transformation on data, and why we do standardization."
  - "I learnt about k-means clustering and what I chose as distance measure has got an impact on the cluster formed!"
- Statements with "doubts" or being "unsure":
  - "I'm confused… It would be good if you can go through [a topic] again"
  - "I am quite unsure when [an example] is a sample or a population"
- Opportunistic students who ask questions:
  - "latent variable (g) and error -- g is unobserverd which is not reflecting in the result or data, so where does this info appear?"
  - "How do we check normality?"

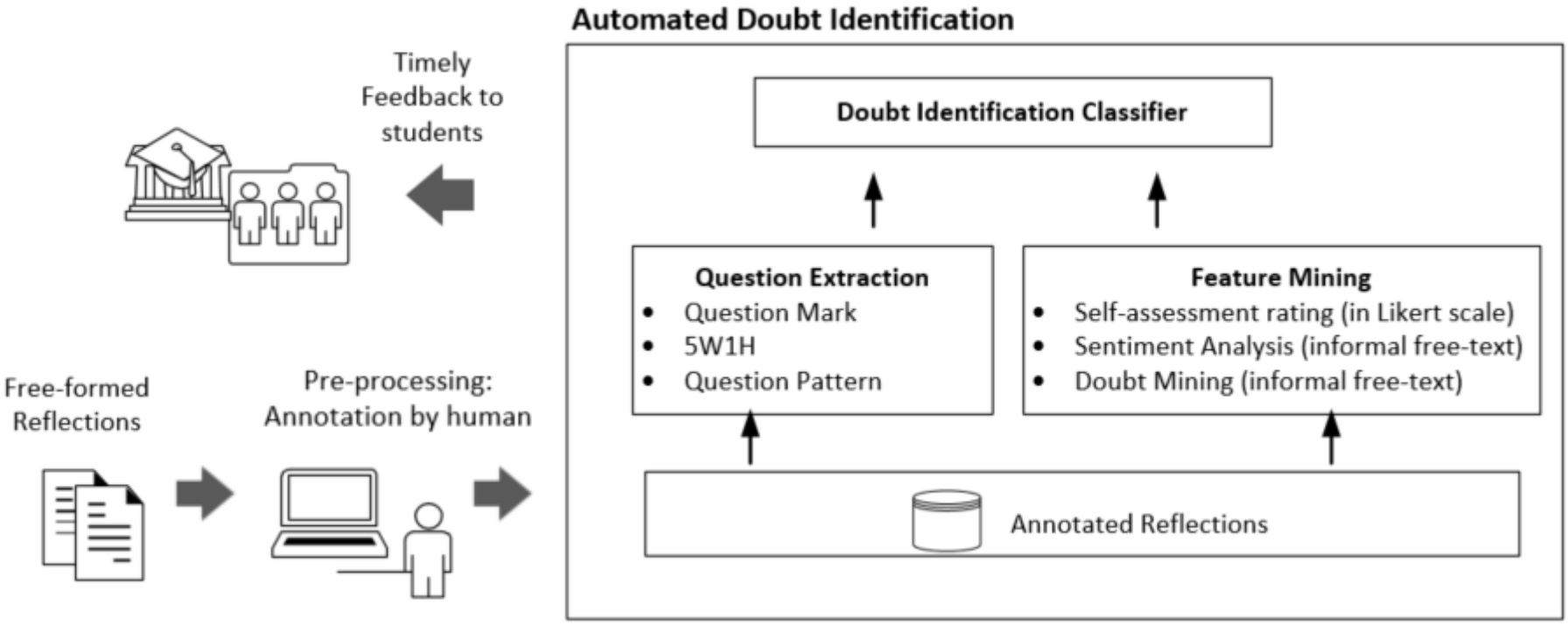
Student's expressions were open, casual and truthful – This were normally not observed in open discussion forums or formal assessments

We define what is a doubt

Doubt :–

is a sentence, which can potentially be a question or simply a statement that requires more clarification of a given topic

We designed an automated doubt mining approach



- Doubt annotation - ‘yes’ or ‘no’ - Does the reflection ask for clarification or additional information?
- Sentiment annotation – ‘positive’ ,’negative’ or ‘neutral’ - Does the reflection express positive/negative feedback or sentiment about the class (e.g., pace, clarity, difficulty)?

We trained the model using data from Instructor 1

Using 375 reflections:

Doubt	
no	295
yes	80

Sentiment	
positive	100
neutral	244
negative	31

Diving deeper into the automated doubt mining model

Question Features Extractions

- Question mark (QM)
- 5W1H method - *who, what, where, when, which, how*
- Rule-based question patterns (QP)
  - *"(pronoun)* [try, like, need] to [find, know]"*

Features Mining for Doubt

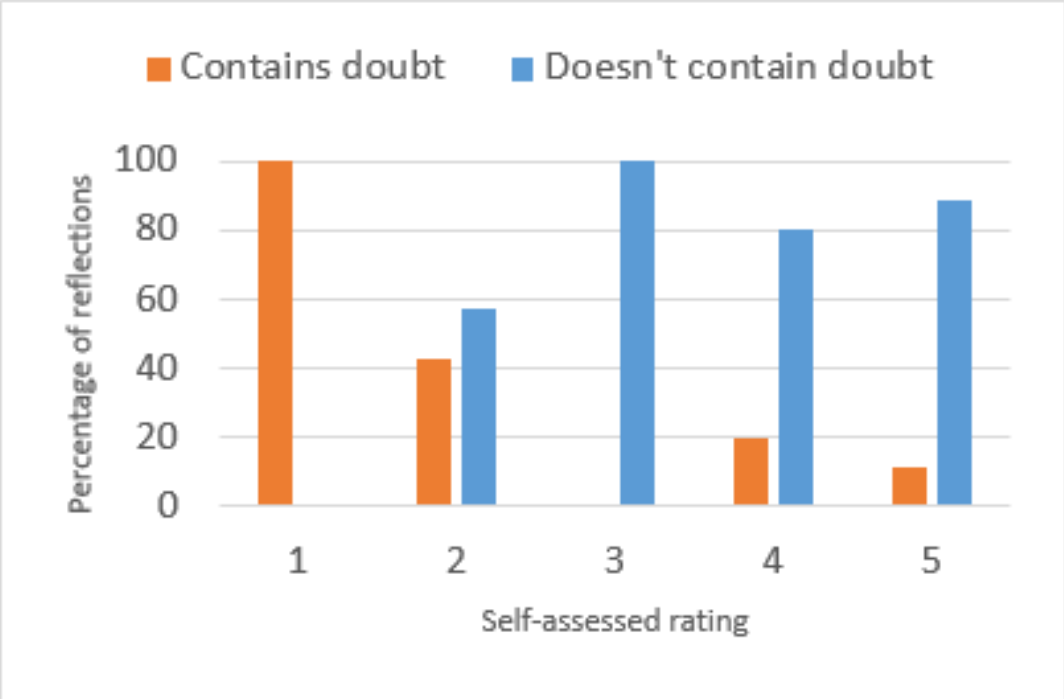
- Self-assessed rating in Likert scale 1 – 5 (with 1 being the lowest rating and 5 being the highest)
- Sentiment
  - positive, neutral, negative
- Text analytics
  - Vector space model (Unigram and/or Bigram) – TF and TF-IDF
  - Neural embedding model - Doc2Vec

The Doubt Identification Classifier was built using Logistic Regression

- **Logistic Regression**
  - 70-30 training and testing using Instructor 1's dataset
  - Evaluated using
    - Precision – true positive over all predicted positive
    - Recall – true positive over all actual positive
    - F1 score – harmonic means of precision and recall
  - Validated using Instructor 2's dataset

We found interesting insights from our study

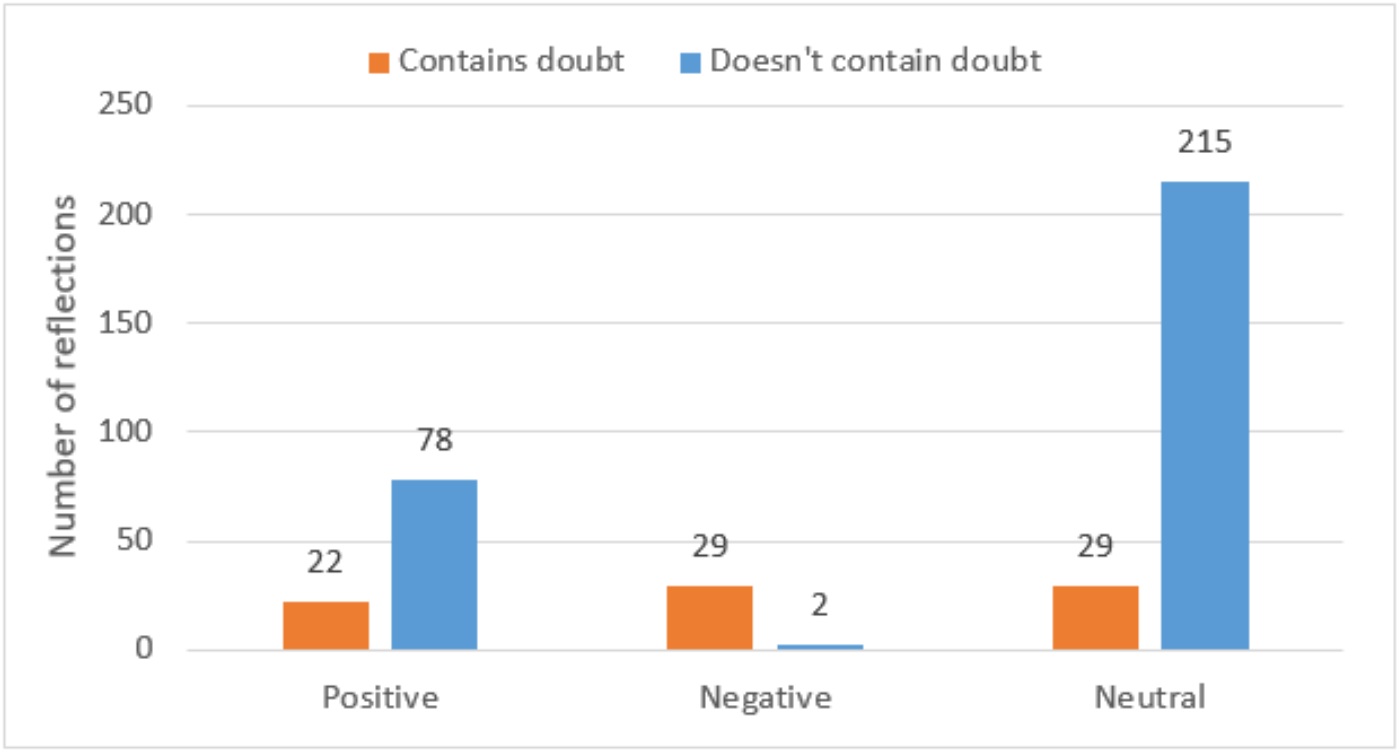
- Insight 1: Lower self-assessed rating has more doubts



- Insight 2: Higher self-assessed rating has doubts too!

How about sentiment analysis?

- Insight 3: Doubts are found across reflections with positive, negative or neutral sentiments



Hence, sentiment analysis alone is not sufficient to identify doubts.

Examples of positive and neutral sentiments with doubtful statements

- (1) Positive + doubt
- "Clustering interesting leh. HAHAHA with the steps and powerpoint animations, very clear can understand. latent variable (g) and error -- g is unobserverd which is not reflecting in the SAS result or data so where does this infor appear ? but error is produced after the data is being analysed right?"

- (2) neutral + doubt
- "I briefly learnt how K-means clustering work and how to interpret the results of a K-means clustering in SAS EG. I felt that I may need a brief revision on SSE."

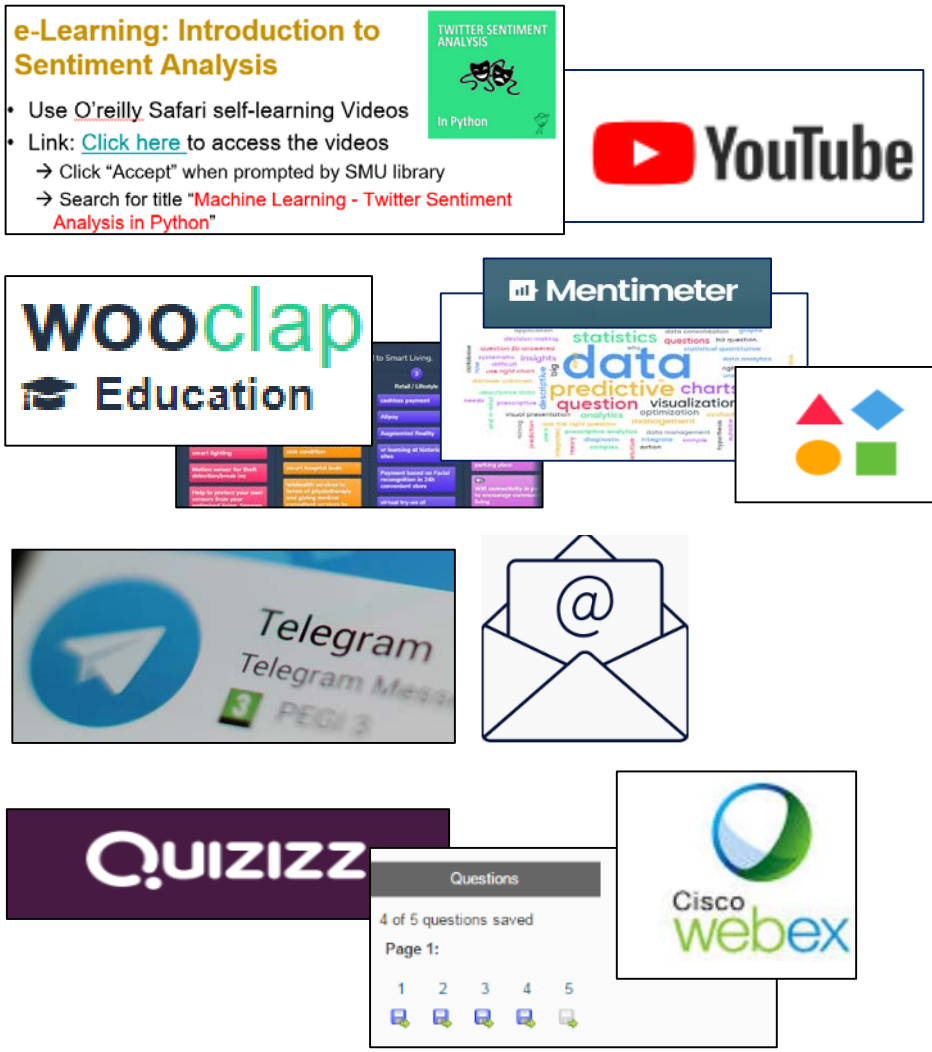
The informal reflections helped instructor shape the learning journey

Supplementary Learning: Online TextBooks or Videos

In-Class Revision and Fun Quizzes

Instant Feedback / Communication with Students:

Post-Class Consultation & Self-Learning:



In summary …

- Using reflections as a learner-centered adaptive learning mechanism to address individual students' concerns have gained positive feedback from students.
- This structured pedagogical method resulted in better learning experiences, higher learner's motivation and meaningful interactions with students.
- Automated doubt-mining relieves instructors from manual administration of reflections, making it easier to adopt personalized learning.

"Effective teaching is to enable effective learning"

Journaling for a longer learning journey