

Human Cognitive Load-Based Learning Content Generation Model (Co-Learning)

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Outline of the Talk

- Issues in Learning Contents for Self-study
- Memory for Learning
- Working Memory in Learning Process
- Co-Learning Algorithm
- Implementation and Conclusion

Issues in Learning Contents for Self-study

Various tools and learning contents are available,
but skillful media creation is needed to create an attractive content for learning!!

Many learning contents are resulting in

- Excessive length
- Monotonous
- Redundant
- Messy
- Language

Effecting in
Learning process



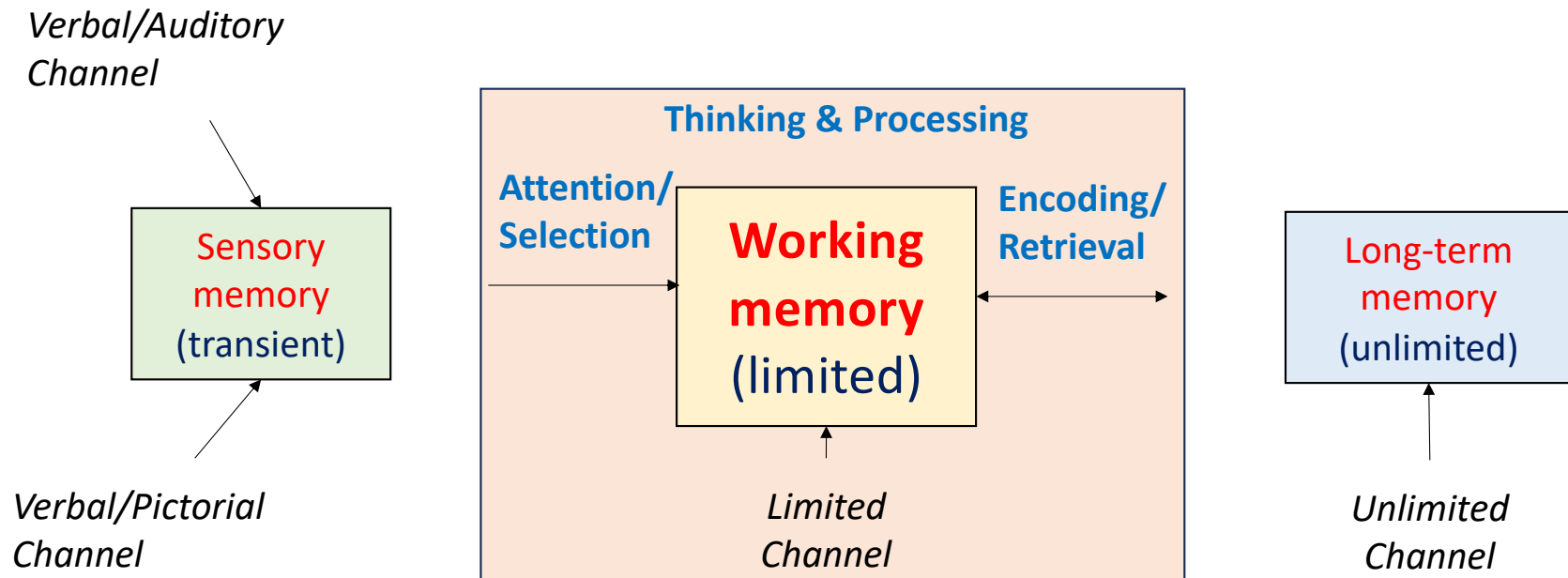
- Concentration
- Interest
- Engagement
- Understanding
- Mother tongue

Classroom Lecture Recording

- Redundancy
- Word corrections
- Hesitation and stuttering
- Error-prone
- Interruptions

Memory for Learning

Components in Human Memory in Learning



Mayer, R. (2003). The Promising of Multimedia Learning: Using the Same Instructional Design Method across Different Media, *Learning and Instruction*, 12, 125-141.

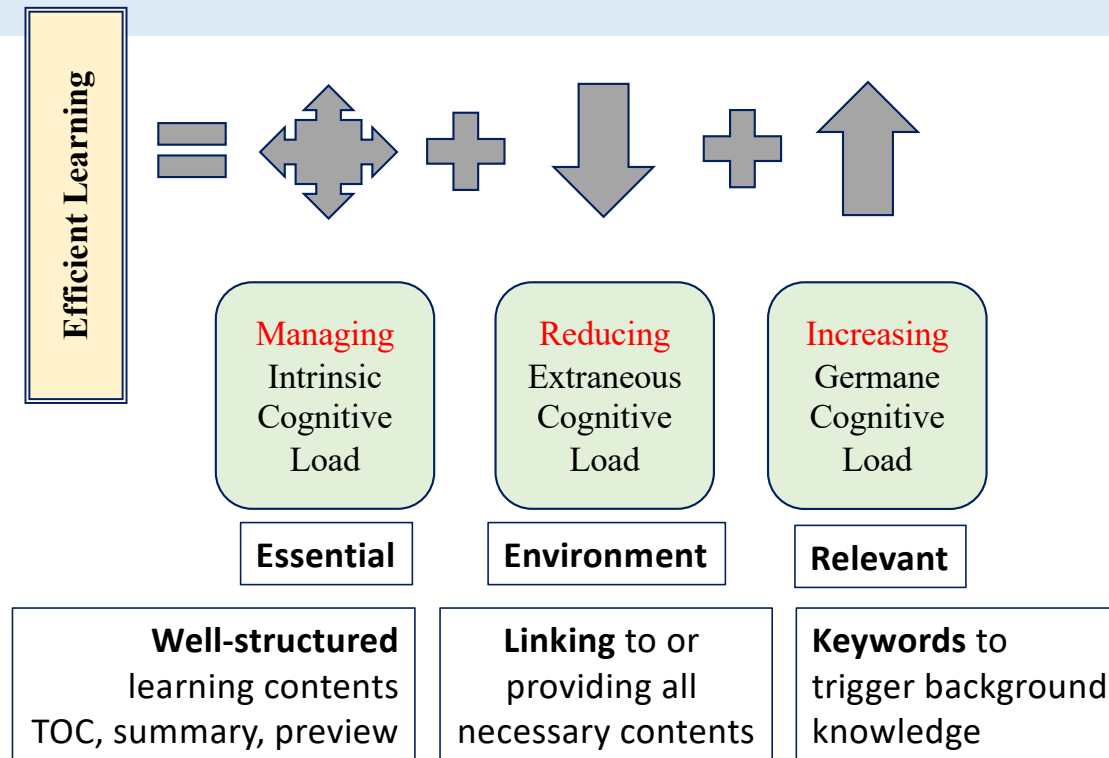
Moreno, R., and Mayer, R. (2007). Interactive Multimodal Learning Environments. *Educational Psychology Review*, 19, 309-326.

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Cognitive Load Theory

- Intrinsic Cognitive Load (Essential knowledge)
 - This is the load imposed by the task itself. This is effectively fixed, but we should try and reduce it by 'chunking' breaking the task down into smaller parts.
- Extraneous Cognitive Load (Peripheral information)
 - This is the environment and the way we present the information. We should try and minimize this.
- Germane Cognitive Load (Relevant to background knowledge)
 - This is the processing that takes place comparing the new information to what we already know and encoding new learning to the long-term memory as schema. The more we know about something the lower the Germane Cognitive Load will be as thoughts and processes are automated.

Working Memory in Learning Process



Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review*, 22, 123- 138.

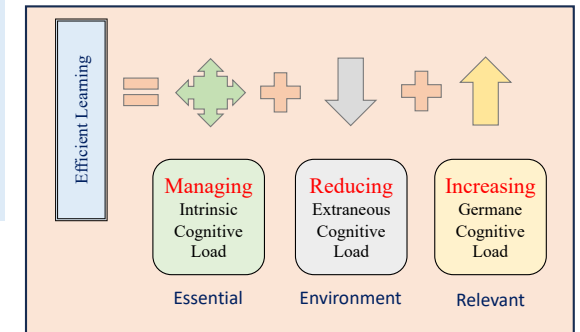
Sweller, J., Ayres, P. and Kalyuga, S. (2011). *Cognitive load theory*. Springer. New York.

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Co-Learning Algorithm

for Learner friendly content creation
designed based on Cognitive Load Theory

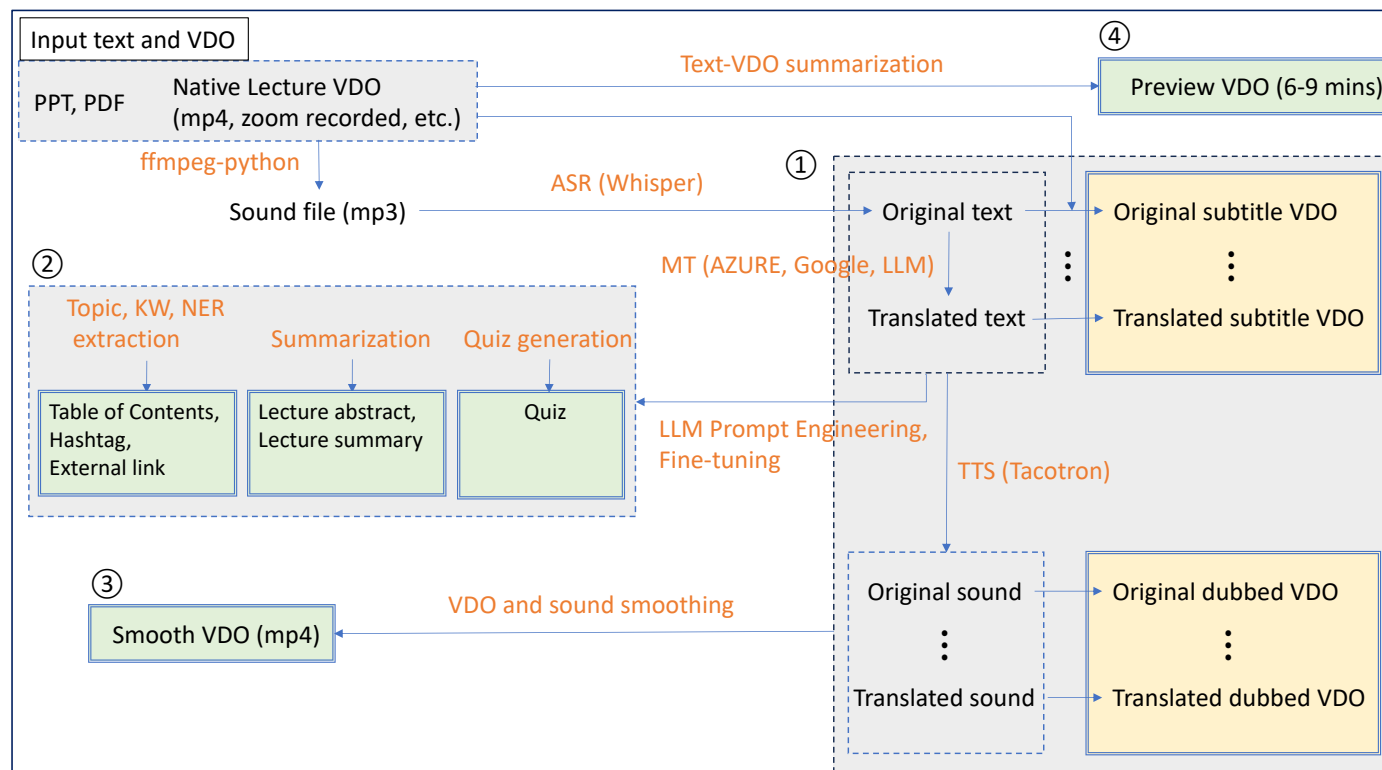
Virach Sornlertlamvanich, et al. (2025). Co-Learning: Cognitive Load-Based Multilingual Learning Content Generation Model, Proceedings of the 35th International Conference on Information Modelling and Knowledge Bases (EJC2025), Ostrava – Poruba, Czech Republic, June 9-13, 2025.



1. Shortening the video length not to exceed 6 minutes based on the Guo et al. (2014) survey that student median engagement time for videos less than 6 minutes long is close to 100%.
Manage intrinsic
2. Providing **TOC or video synopsis** to give content structure.
3. Summarizing the content for quick view of the contents.
4. Indexing the content for keyword search and scene search.
5. **Linking** from one video to other related videos for total understanding.
Reduce extraneous
6. Categorizing the videos for better accessibility.
7. Extracting **keywords** for better representation of the content.
Increase germane

Co-Learning Model Architecture

Virach Sornlertlamvanich, et al. (2025). Co-Learning: Cognitive Load-Based Multilingual Learning Content Generation Model, Proceedings of the 35th International Conference on Information Modelling and Knowledge Bases (EJC2025), Ostrava – Poruba, Czech Republic, June 9-13, 2025.

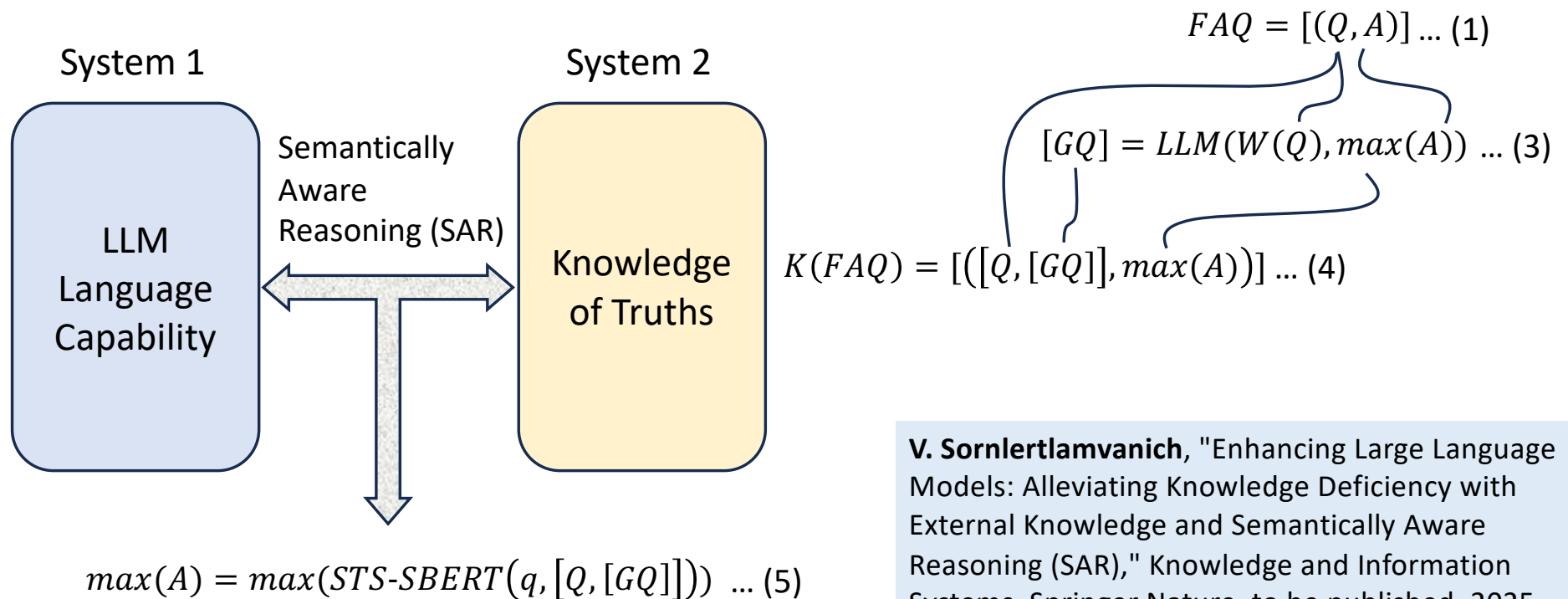


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- ① Subtitles, translated and dubbed versions generation
- ② Summary, quizzes, TOC generation
- ③ Noises, stuttering, redundancy reduction
- ④ Preview VDO generation

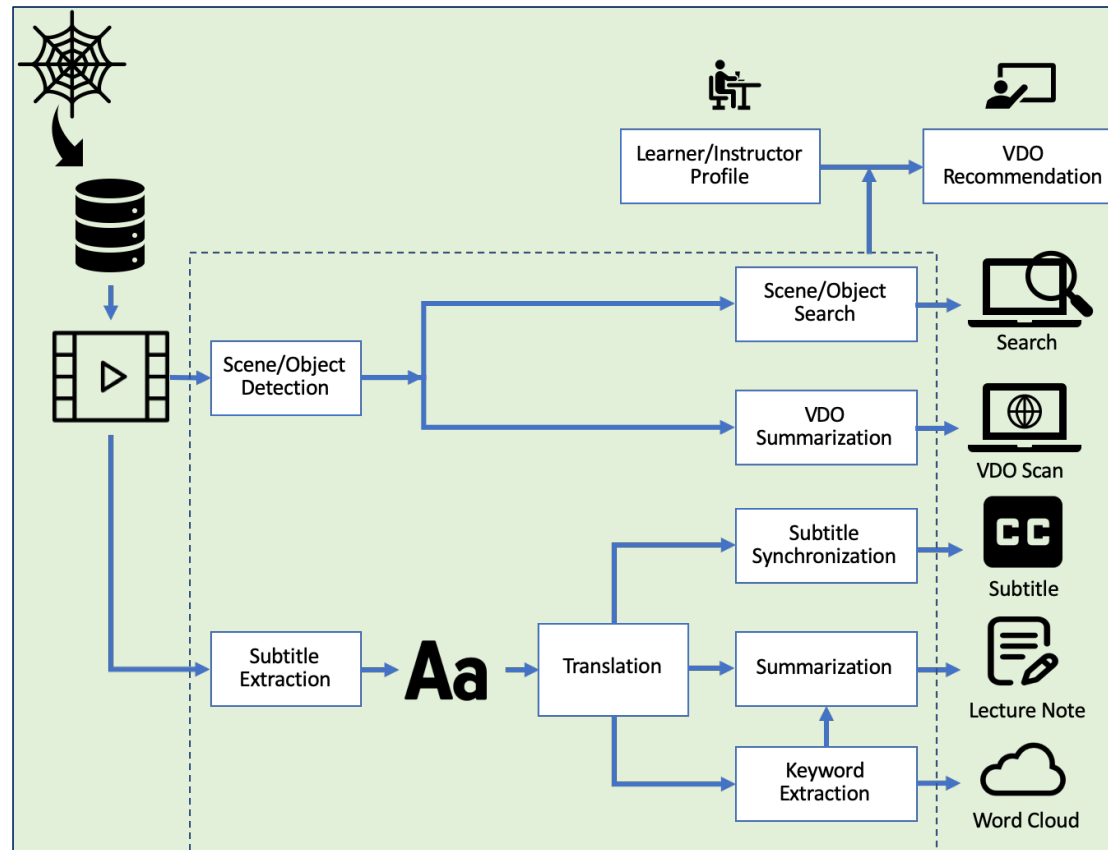
Semantically Aware Reasoning (SAR) or Semantic Reasoning with Conscious Capability

Linking LLM as a System 1 and knowledge encapsulated System 2



V. Sornlertlamvanich, "Enhancing Large Language Models: Alleviating Knowledge Deficiency with External Knowledge and Semantically Aware Reasoning (SAR)," Knowledge and Information Systems, Springer Nature, to be published, 2025.

Co-Learning System Implementation



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Co-Learning as an Education Partner

Chapter

Chapter

Chapter

0:00 - 10:00 - Introduction to Acoustic Phonetics
Main idea: To provide an understanding of phonetics and its importance in speech processing.
Details:
Phonetics is the study of sounds in human speech. It includes articulatory phonetics (production of sounds), and auditory phonetics (perception).
The role of phonetics in automatic speech recognition (ASR) and how it helps in understanding speech.

10:00 - 25:00 - Acoustic Analysis Techniques
Main idea: Explaining tools and methods for analyzing speech sounds.
Details:
Sound Spectrograms: Visual representation of sound intensity over time, showing different frequency components.
Fourier Transform (FT) and Short-time Fourier Transform (STFT): Used to convert time-domain signals into frequency components.
Mel-Frequency Cepstral Coefficients (MFCCs): Widely used features in ASR that mimic human hearing.

External link

WIKIPEDIA
The Free Encyclopedia

Search Wikipedia

Convolutional neural network 28 languages

Contents hide

From Wikipedia, the free encyclopedia

For other uses, see **CNN** (disambiguation).

This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.
Find sources: "Convolutional neural network" – news · newspapers · books · scholar · JSTOR (June 2019) (Learn how and when to remove this message)

A convolutional neural network (CNN) is a specialized type of feed-forward neural network.

Part of a series on **Machine learning**

世界の幸せをカタチにする。



Co-Learning - CONNECTIVE LEARNING

Professor/Instructor: Prof. Virach Somlertamvanich

Lecture VDO Selection: J-ISR-CH4_Convolutional_Neura...

Select language: English (US)

Lecture Video

Wordcloud

Convolution

$$(1 + 0 + 0) + (0 + 1 + 0) + (1 + 0 + 1) = 4$$

$$(I * K)_{ij} = \sum_{k=1}^K \sum_{l=1}^L I_{k+l-1, j-l+1} \cdot K_{kl}$$

Summary

Convolutional Neural Networks (CNNs) are a class of deep neural networks primarily used for image recognition and pattern detection. Inspired by the human visual system, CNNs are widely used in computer vision tasks, such as image classification, object detection, and medical imaging.

Basic Architecture of CNNs: CNNs consist of several key layers: the convolutional layer, pooling (subsampling) layer, and fully connected layer.

Quiz

Quiz

Question 1: CNNにおける畳み込み層の役割は何ですか？

Select an answer

☐ A. 入力画像から特徴を抽出する

☐ B. 過学習を防ぐ

☒ C. 活性化関数を適用する

☐ D. 重みを最適化する

Wrong! X

Question 2: CNNで一般的に使用される活性化関数はどれですか？

Select an answer

☐ A. Sigmoid

☐ B. Tanh

☒ C. ReLU

☐ D. Softmax

Correct! 〇

Question 3: CNNにおける最大池化層の主な目的は何ですか？

Select an answer

☐ A. 特徴マップのサイズを減らす

☐ B. 計算量を削減する

☒ C. 特徴マップの最大値を抽出する

☐ D. 重みを初期化する

Correct! 〇

Question 4: 畳み込み層の出力を正規化するために使用される手法はどれですか？

Select an answer

☐ A. Batch Normalization

☐ B. Layer Normalization

☒ C. Group Normalization

☐ D. Instance Normalization

Correct! 〇

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	Video title 1	Video title 2	Video title 3	Video title 4
No. of students	79	80	83	72
No. of responses	79	77	82	68
Positive	71	47	30	63
Comments	Ability to prepare and review videos with a summary and a quiz	Improved quiz result display, making it easier to use than before	Enhanced word cloud functionality compared to the previous version	Organizing non-wordcloud information into three tabs creates a neater, more user-friendly interface
	Clear and easy-to-understand subtitles that facilitate learning	Improved word cloud displaying more relevant content	Better Chinese subtitles and audio quality than before	Wordcloud and other features have become much more user-friendly, making the tool feel highly effective
	Useful functions such as summaries, English subtitles, and voice narration	Conveniently locating the exact time to play corresponding videos while reviewing summary content	Effective learning through the quiz format, with summaries assigned to each topic for better comprehension	Implemented improvements enhance usability, with wordcloud showing significant improvements
	Instant quizzes effectively reinforce understanding			
Negative	8	30	52	5
Comments	Difficulty figuring out how to navigate to another page in the quiz	Subtitles disappearing from the screen after a certain period	White subtitles making them slightly difficult to read	Improved ease of viewing when items were separated, though overlapping subtitles sometimes reduced readability
	Wordcloud displaying different keywords for different languages	Difficulty reading slide content due to subtitle color and font	Picture quality issues and overlapping subtitles being slightly distracting	Video being easier to watch if the subtitle color were corrected
	Quiz selection resetting when changing a page	Irrelevant words being extracted in the wordcloud	Concerns about subtitle timing and readability, though reviewing them in the video remains convenient	
		Chinese pronunciation sounds unnatural	Poor image quality and difficulty reading text in the painting	

Evaluation result

Positive (70%):
Most of them are related to system contents

Negative (30%):
Most of them are related to UI

Conclusion

- **Connective learning:** a process learning from connecting to the background knowledge
- **Learning content refinement:** we connect the SOTA NLP techniques to refine and generate the content that leverage the learning efficiency according to the Cognitive Load Theory and Human Learning Process.
- **Model architecture:** we propose the architecture of Multi-lingual Co-Learning model that bridges the gap between the challenges faced by learners and lecturers in the current digital learning landscape.