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Multi-lingual Support in Connective Learning Scheme for Refining and Connecting the Open Educational Videos

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Abstract

Tons of educational videos are available online. It is a big burden for learners to figure out the videos they need in the preferred time and language. Not all videos are suitable for learning according the length and presentation components. According to the Sweller's cognitive load theory, the working memory in learning process is very limited, the learner must be selective to what information from sensory memory to pay attention. In the connective learning, we effectively apply NLP approach to refine the video subtitle in archiving, translating, summarizing, classifying, and labelling the relevant keywords to create the multi-lingual learner-friendly environment.

Keywords: Connective Learning, Multi-lingual, Educational Video

Résumé

ปัจจุบันมีวิดีโอเพื่อการศึกษาที่เผยแพร่ออนไลน์มากมาย จึงเป็นการไม่สะดวกสำหรับผู้เรียนในการหาวิดีโอที่ต้องการได้ ซึ่งส่วนใหญ่ก็ต้องเลือกดูบางส่วนก่อนเพื่อให้ทราบเนื้อหา และวิดีโอส่วนใหญ่ก็เป็นภาษาอังกฤษหรือภาษาอื่นๆ ที่ผู้เรียนไม่สันทัดมากนัก จากทฤษฎีการเรียนรู้ (cognitive load theory) ของ Sweller ที่ได้กล่าวไว้ว่าในกระบวนการเรียนรู้ผู้เรียนจำเป็นต้องอาศัยหน่วยความจำชั่วคราว (working memory) ซึ่งมีพื้นที่จำกัด ดังนั้นเพื่อให้การเรียนรู้มีประสิทธิภาพสูงสุด งานวิจัยนี้ได้นำเสนอการใช้การประมวลผลภาษาธรรมชาติเพื่อช่วยในการจัดเก็บคำบรรยายประกอบ แปลคำบรรยาย ย่อความ จำแนก และสกัดคำสำคัญสำหรับการนำเสนอบทเรียนด้วยภาษาที่ต้องการและปรับแต่งให้เป็นวิดีโอที่เหมาะสมตามทฤษฎีการเรียนรู้

1. Introduction

The number of educational video titles drastically increases and covers a wide area of study. Many learners are seeking for additional learning materials to complement their understanding about lessons just learned in the classes. These educational videos are also intentionally used by the lecturers to complement the lessons taught in the classes. However, it is not easy to search and scan the tremendous files from the collections. Though they are classified by topics or the tags, it still consumes a lot of time to watch the whole bunch of the applicable videos. If learners do not watch the videos, they cannot learn from them. According to the Guo et al.'s survey, learner engagement drops off when the video length is getting longer. The median engagement time with 9-12 minute videos is about 50% and the median engagement time with 12-40 minute videos is about 20%. The maximum median engagement time for a video of any length was six minutes. Making videos longer than 6-9 minutes is therefore likely to be wasted effort. Our proposal is to archive the open license available videos and prepare them in the form to promote learner engagement and ready to learn.

2. Availability of Educational Videos

The growth of educational videos, nowadays, is leaping forward measuring in either the number of videos produced and presented on the internet or the number of users' visits. The statistics from the market survey in 2018 by Marketing Charts, as shown in Figure 1, illustrates that video viewership on Facebook and YouTube increased by up to 51.6% for business on Facebook and 23.4% on YouTube. In the educational field, there is also a significant increase of 10.2% on Facebook and 11.2% on YouTube, which is the third-highest in comparison statistics report (Erickson D. 2019).

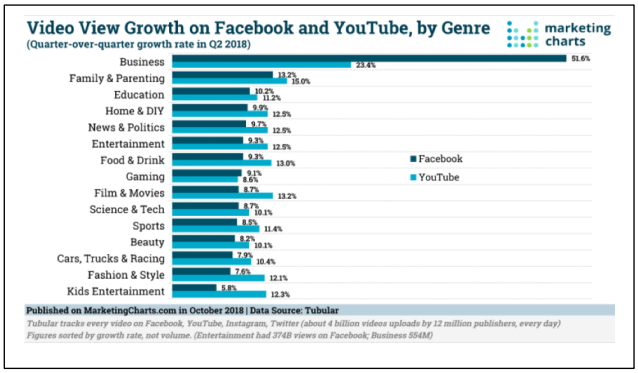

Figure 1: Video view growth on Facebook and Youtube in 2018

When there is high demand, the amount of supply that produces video for learning is higher too. It increases likely much more according to the increasing needs of online learning. There are two explicit types of online learning available on the internet. The first one is the direct learning in the system of education through the E-learning system of educational institutions such as TUXSA, the online Master degree of Thammasat University and Spillane Company (https://www.skilllane.com/academic/tuxsa?), Chula Mook of Chulalongkorn University (https://mooc.chula.ac.th/courses). The second one is an additional learning from open courses such as Khan academy (https://www.khanacademy.org), Udemy (https://www.udemy.com), Fast AI (https://course.fast.ai), Coursera (https://www.coursera.org) as well as videos that are commonly distributed on YouTube. As the big volume of the growth of online learning, video collection services are introduced and available for learning from various

sources and for accessing easily, with the public license of YouTube, such as the Open Culture (http://www.openculture.com) where videos are categorized by academic field and accessibility. As a result, learners are able to find the exact learning video they need to learn.

3. Cognitive Load

Cognitive Load Theory, proposed by Sweller et al. (2011), suggests that memory has several components as shown in Figure 2. Sensory memory is transient, collecting information from the environment. Information from sensory memory is selected for temporary storage and processing in working memory, which has very limited capacity. This processing is a prerequisite for encoding into long-term memory, which has virtually unlimited capacity. Because working memory is very limited, the learner must be selective about what information from sensory memory to pay attention to during the learning process, an observation that has important implications for creating educational materials.

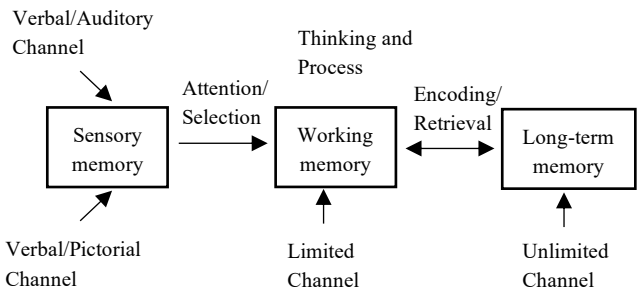

Figure 2: Components in memory based on Mayer (2003), and Mayer and Moreno (2007)

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However, the educational videos available on Youtube are not always appropriate for learners. According to the Cognitive Load theory, initially articulated by Sweller and colleagues (Sweller et al. 1988, 1989, 1994), suggests that memory has several components as shown in Figure 2. Because working memory is very limited, the learner must be selective about what information from sensory memory to pay attention to during the learning process, an observation that has important implications for creating educational materials. The video length is one of the significant factors that affect the learner engagement and memory as well as the structure and content of the video. This research, therefore, aims to propose a set of text processing techniques to collect, categorize and modify the videos to be suitable for human learning processing in terms of video length, video relativity and content structure according to the Cognitive Load theory.

Based on this model of memory, Cognitive Load theory suggests that any learning experience has three components. Those are,

1. **Intrinsic Cognitive Load** – 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.
2. **Extraneous Cognitive Load** – This is the environment and the way we present the information. We should try and minimize this.
3. **Germane Cognitive Load** – 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.

The efficient learning, as shown in Figure 3, can occur when Working Memory Capacity is greater than the sum of Extraneous Cognitive Load, Germane Cognitive Load, and Intrinsic Cognitive Load (Sweller et al. 2010). Reducing extraneous load by helping novice learners with the task of determining which elements within a complex tool are important, and it can also increase germane load by emphasizing the organization of and connections within the information. Managing intrinsic load, and it can also increase germane load by emphasizing the structure of the information.

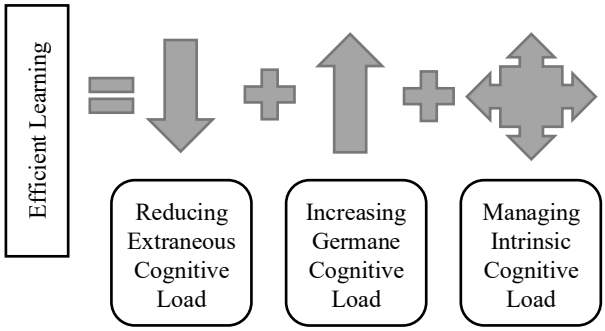

Figure 3: Working memory in learning process based on Sweller (2010)

Following the Cognitive Load theory, we propose a set of effective NLP techniques to manage the educational video resources by

1. Shortening the video length not to exceed six minutes based on the Guo et al. (2014) survey that student median engagement time for videos less than six minutes long is close to 100%.
2. Categorizing the videos for better accessibility.
3. Providing video synopsis for better structure.
4. Extracting keywords for better representation of the content.
5. Indexing the content for keyword search and scene search.
6. Summarizing the content for quick view of the contents.

7. Linking from one video to other related videos for total understanding.

4. Connective Learning Scheme

The system is experimentally implemented in the public cloud system. The target videos are collected with the subtitle files and archived in the cloud database. The subtitle text files are translated to any the target languages (such as Japanese, Chinese, and Thai) by Google Translate API. The resulting translation files are manipulated as source files for each language processing. Keyword extraction, summarization and video synchronization are conducted in parallel with a relating unique ID to realize the video multilingual services.

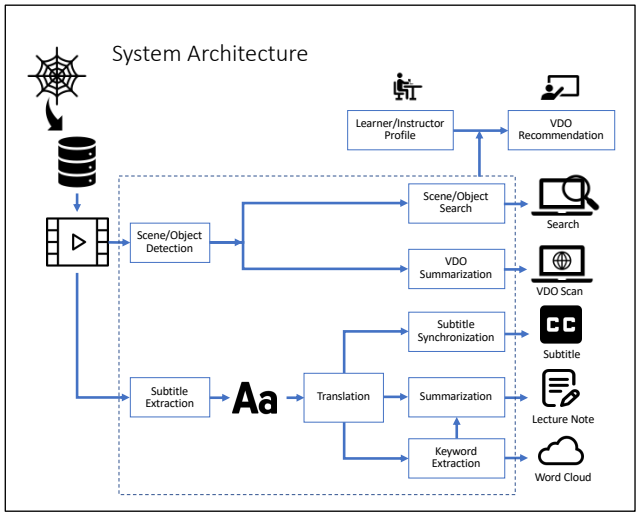

Figure 4: Connective learning system architecture

Figure 4 shows the system architecture of the proposed connective learning. The flow is started from video files crawling from the publicly open video sources available in the Internet according to their open pubic license. Video subtitles are extracted and processed in accordingly to their video contents. Text processing techniques are applied to extract the keywords, summarized and indexed.

At the same time, the video files are analyzed to detect the objects and scene representations. The preliminary experiment on video analysis is conducted to support video summarization and scene search. Finally, video recommendation based on learner view history and profile can be considered, and the instructor curriculum fulfillment function can be extended.

The system efficiently provides video playback, summary, word cloud annotated with a hyper link, scene search under the multilingual service environment. As a result, a learner can browse the summary and word cloud to understand the structure of the content before starting the video playback. A hyper link to external webpages supports the additional explanation. Scene search can direct the learner to the desired scene. The available learning videos are finally connected to realize the efficient learning environment.

Figure 5 shows one possible service of the proposed connective learning for multi-lingual learning environment.

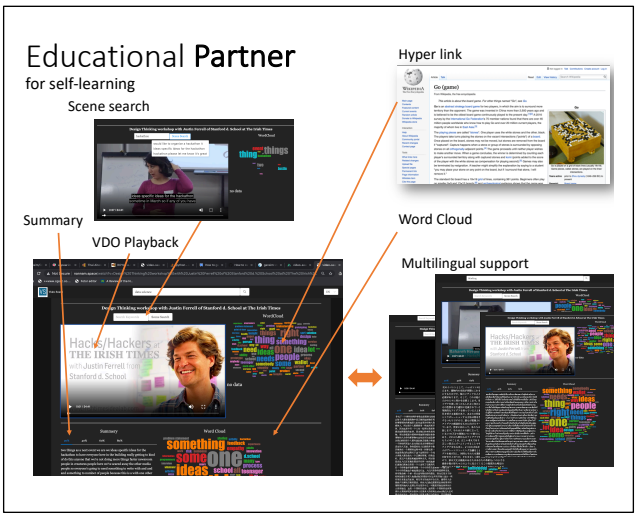

Figure 5: Connective learning system for multi-lingual service

5. Conclusion

The proposed connective learning is a result of connecting the analyzed learning video by summarizing the contents into a well-structured form of keywords, linked to external source of information. The translated contents helps reducing the inequality in education. The efficient learning can be realized by the NLP refinement based on the cognitive load theory accordingly, i.e. summarize to reduce extraneous cognitive load, scene search and external link to increase Germene cognitive load, and classify to mange intrinsic cognitive load.

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