

Instructional Video, Memorization, and Effective Learning

Using streamed lecture videos to construct effective learning outcomes

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BACKGROUND

Since technology prevails in today's classrooms, Case Western Reserve University (Case) has started to record large, introductory, lecture-based undergraduate lectures and make the videos available online. Through high speed internet and streaming technology, students can now study by watching previously recorded class lectures from their dorm rooms, living rooms, or anywhere else they happen to be.

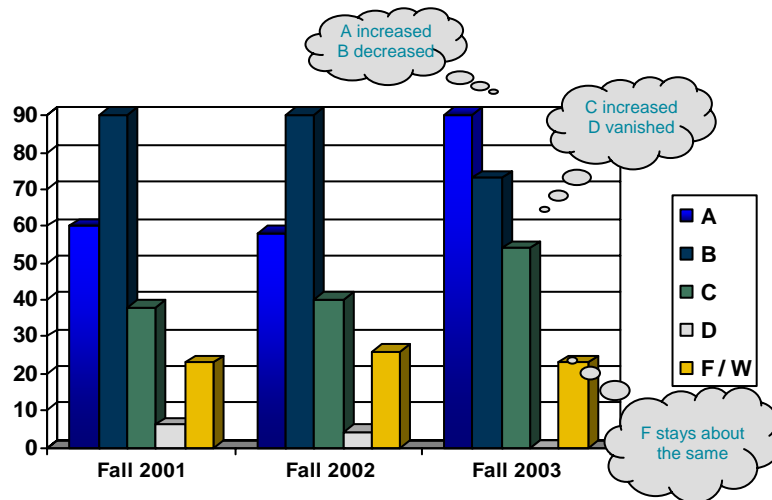
These streamed lecture videos synchronized with PowerPoint slides are bundled in a cyber-course environment, called MediaVision Courseware. Studying tools in the Courseware also include a video/clip search engine, review session videos (TV show, Lab experiments, recitations, etc.), course material uploads, MP3 audio lecture downloads, and supplementary readings (i.e. integrated on-line textbook).

Each lecture video is broken down into several short topic-oriented clips with assigned metadata (title, keyword, and description). Students are able to view previous lectures in multiple ways – 1). Watch the entire 50-min video, 2). Search video clips by keywords/concepts, and 3). Select video clips from a story board (video is separated into small 1 minute clips on the story board).

The pioneer course that integrates with MediaVision Courseware technology is Chemistry 105 (CHEM 105). Professor Ignacio J. Ocasio (Doc Oc), one of the most popular Case professors, had taught CHEM 105 with similar curriculum and instructional strategies for over 20 years. Since professor Ocasio had kept a completed student assessment records, it was helpful to compare previous data with the assessment outcome after the lecture videos were implemented in the class.

Not surprisingly, the results were positively phenomenal (Figure 1). With streaming lecture videos, students were able to improve their course performance dramatically.

Figure 1: Student Learning Outcome Assessment



Based on the chart (Figure 1), the population of "D" students almost vanished while the population of "C" students increased after implementing streaming lecture video technology in the instructional strategy. Also, the population of "B" students decreased while the population of "A" students increased.

Mayer (1997) states that "contiguous presentation of visual and verbal material may be most important when the material is cause-and-effect explanation of a simple system, when the learners are inexperienced, and when the goal is meaningful learning." The results of student's performance improvement evidence this notion, because

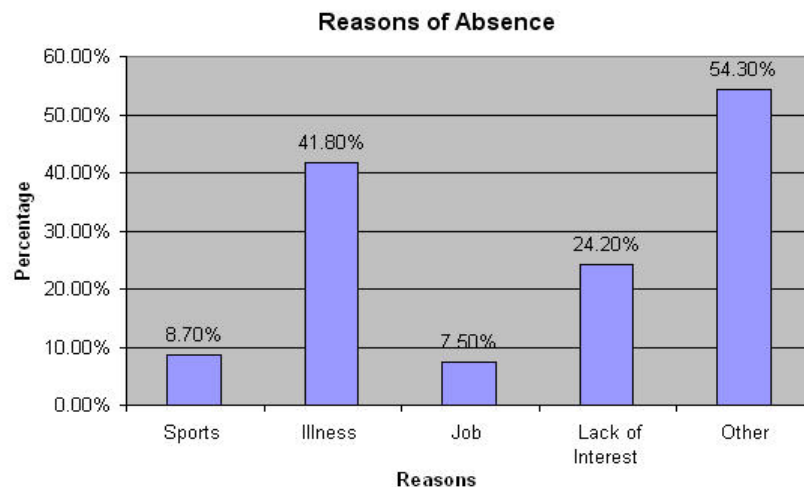
- (1) Dual-Coding Design: The streamed lecture video not only integrates both visual (PowerPoint Graphics) and verbal (Professor's Speech) material synchronously, but also allow multiple access by students voluntarily.

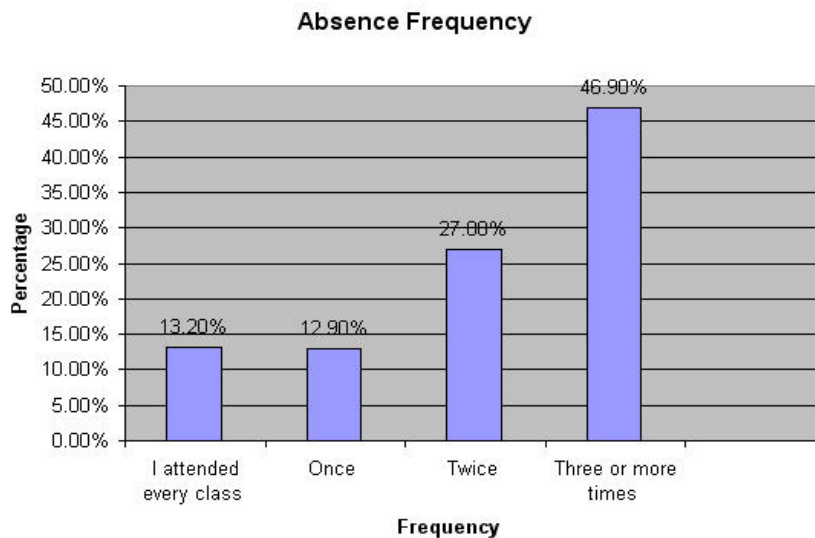
(2) Inexperience Novice: The MediaVision courseware technology is targeted at large lecture-based undergraduate introductory (freshman) courses, students who have access to the streamed lecture videos are considered inexperienced novices in the discipline.

(3) Meaningful Learning Objectives: These are introductory courses and the professors usually have years of teaching experience, the curriculum of these courses are designed around specific learning goals and objectives.

Today, MediaVision courseware has supported over 15 courses for more than 2000 students at Case Western Reserve University since August 2003. Based on the previous investigations (MediaVision, 2003, 2004, and 2005), we have learned that streaming lecture video not only allows students to review the concepts that were introduced and the parts that they did not understand in the class, but it also helps students make up missing lectures (Figure 2). Nowadays, the MediaVision courseware technology becomes one of the crucial learning tools that Case students use to engage their learning success.

Figure 2: Student's Class Absence Information (© 2005, M. Mace)





INTRODUCTION

At present, we understand that the streaming lecture videos in the MediaVision courseware facilitate student's learning. However, it is not clear what the rationale is in making such exceptional learning success possible. The purpose of this study is to explore whether reviewing previous lectures continuously would (1) engage better knowledge memorization, (2) facilitate better concept comprehension, and finally (3) initiate better problem solving abilities. Please note: this paper only focuses on the knowledge memorization portion of the study.

The impact of the dual coding system in knowledge memorization

According to previous studies, the construction of a verbal representation from a visual stimulus (or vice versa) develops a referential connection, which allows information to be remembered and recalled easier, since when one memory trace is lost, the other remains available (Charl & Paivio, 1991; Mayer and Moreno, 2002; Mayer and Sims, 1994; Steffensen, Goetz, & Cheng, 1999; Kuo and Hopper, 2004). Mayer (1999) indicates that constructive learning occurs when learners are able to build such referential connections between corresponding aspects of the visual and verbal representations. It is fostered when the learner is able to hold a visual

representation in visual working memory and a corresponding verbal representation in verbal working memory at the same time (Mayer et al., 1999).

In summary, meaningful learning occurs when learners construct and coordinate multiple representations of the same material, including visual and verbal representations (Houghton & Willows, 1987; Schnotz, 1993; Schnotz & Kulhavy, 1994; Willows & Houghton, 1987; Mayer, 1997). Using the lecture video as an example, it not only allows students to “review” lectures that they have previously participated in personally as many times as they wish, but also the knowledge is being presented with multiple mediums during the continuous video viewing process, such as PowerPoint slides (graphics and outline text), professor’s speech (verbal), and written notes on the board (chart, formula, keyword/text, etc). It is under the assumption that this kind of multi-dimensional learning experience constructs knowledge and engages meaningful and effective learning consequences.

Cognitive tools are instruments that can enhance the cognitive powers of learners during their thinking, problem solving, and learning (Jonassen & Reeves, 1996; Kozma, 1987; Pea, 1985; Salomon et al, 1991). Lecture videos synchronized with PowerPoint slides provide students a visual (slide graphics, and the blackboard notes in video) and verbal (professor’s speech, and the slide text content) dual-coding (Paivio, 1986) learning experience. The question here is whether the knowledge that students obtain in the lectures could be recalled during the video reviewing process, and whether this kind of continuous dual-coding, realistic class representation allows learners to construct meaningful mental representations from presented information (video), which initiates advanced memorization and comprehension.

RESEARCH METHOD

In this study, I will conduct two experiments (1) Questionnaire (2) Experimental lecture series. The first experiment will help us to learn about the student's usage and stratification of the system. According to Kauffman (2004), a student must possess the will to learn. No matter how powerful the technology is, it has to be used in order to present its maximum impact. The hypothesis for this experiment is that most students have watched the lecture videos, and that they believe the system helps to improve their learning quality.

In the second experiment, I would like to develop an experimental lecture series to discover the relationship between live lectures, recorded videos, and student's memorization. I would like to find out how the video reviewing experience influences learner's knowledge memorization ability.

EXPERIMENT 1 – Questionnaire

Before exploring the impact of lecture videos in student's knowledge memorization, it is valuable to investigate whether students are actually using the system, and what they think about the benefits of using it.

There are two questions included in this survey and all 2005 MediaVision course students are invited to provide their feedback. The questions are

1. Usage Frequency - How often have you logon to the course site to view videos?
2. User's Confidence in technology - Do you find the lecture videos are helpful for your learning/study?

EXPERIMENT 2 – Mini lecture series

The purpose of this experiment is to produce a sample lecture series to test student's memorization ability, with and without, lecture video enhancement.

The design of this experiment is to develop a mini lecture series based on the theme of a Chinese Legend (*The Eight Immortals Crossing the Sea*). The lecture series includes three 30-min lectures, which will be offered every other day, for a week. A sample of 200 volunteer students from MediaVision courses will participate in this study. In order to ensure all participants do not have any prior knowledge about the story before the lecture, they will be tested before the experiment. Only the ones who never heard of the story are qualified to participate in this study.

These qualified participants will be separated into two randomly and evenly selected groups (Table 1). Each mini lecture is designed for specific learning goals and with PowerPoint technology integration. The PowerPoint slides will be developed as a graphic story book with outline text (Figure 3). A hard copy of the full-text story is considered as textbook function and will be given to students a week before the lecture. The lecture material (handouts) is organized in the matrix style (Figure 5), will be given during the lectures. After each lecture, students in the control group will be offered a hard copy of the PowerPoint slides while students in the experimental group will be offered a web link to the lecture videos.

Table 1: Control Group vs. Experimental Group

Group	Instruction	Study Tool	Review Method
Control	Lecture with PowerPoint Slides	Handout with Matrix Notes	Full-text Story and hard copy of the PowerPoint slides
Experimental	Lecture with PowerPoint Slides	Handout with Matrix Notes	Full-text Story and Lecture Video synchronized with PowerPoint slides

Lecture One – Introduction (Building prior knowledge)

According to the book of “Models of Teaching” (Joyce et al, 2004), the heart of the memory procedure is connecting two ideas. For example: we can either associate words with meanings, events with dates, names with ideas, etc. Since all participants have no prior knowledge about the story, the first lecture is designed to provide variety of information for students to visualize the story background, obtain information, and build connections later on.

Figure 3: Sample PowerPoint Slide

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METHODOLOGY

The 8 Immortals crossing the sea

Clockwise in the boat starting from the stern:

1. He Xian-gu (何仙姑)
2. Han Xiang-zi (韓湘子)
3. Lan Cai-he (藍采和)
4. Li Tie-quai (鐵拐李)
5. Lü Dong-bin (呂洞賓)
6. Zhong Li-quan (鍾離權)
7. Cao Guo-liu (曹國舅)
8. Zhang Guo-lao (張果老)

The Eight Immortals crossing the sea, from *Myths and Legends of China*, 1922 by E. T. C. Werner.

To learn more about this story, please visit wikipedia at http://en.wikipedia.org/wiki/Eight_Immortals

The instructor in this lecture will discuss the origin of the story, related terms, related literatures, art work, worship, dynasty characteristics, story characters, etc.

The outline of the lecture is as followed:

1. The origin of the “Eight Immortals”
 - a. The book of “The Journey to the East” by Wu Yuan-tai, Ming dynasty
 - b. The origin of the legend (as Eight Immortals Cross the Sea, each reveals his/her own divine power)

2. The story background
 - a. The Conference of the Magical Peach (蟠桃會 pán taó huì)
 - b. The role of dragon kings in ancient Chinese legend
 - c. The eight immortals and their magic tools
3. The antique art piece, ancient Chinese lectures, Chinese tourist attractions that are associated with the eight immortals
 - a. *The Yueyang Mansion* (岳陽樓) by Ma Zhi-yuan
 - b. *The Bamboo-leaved Boat* (竹葉船) by Fan Zi-an
 - c. Eight Immortals Palace (八仙宮)
 - d. Eight Immortal Temple (八仙廟)

As mentioned earlier, the full-text story (Figure 6), which is treated as a textbook in this case, will be given to students a week before the lecture for previewing. During the lecture, a handout with matrix notes (Figure 5) will be offered to students for review. Several previous studies suggest “learning advantages for students who take notes in a matrix style as compared to students who take notes in free form” (Kiewra, 1991; Kauffman, 2004). By offering handouts in matrix style, I hope to improve student’s memorization ability of the lecture content in this study. After the lecture, the students in the control group will receive a hard copy of the PowerPoint slides while the students in the experimental group will obtain a web link of lecture videos (Figure 4).

Figure 4: A sample of Lecture Video Viewing Screen

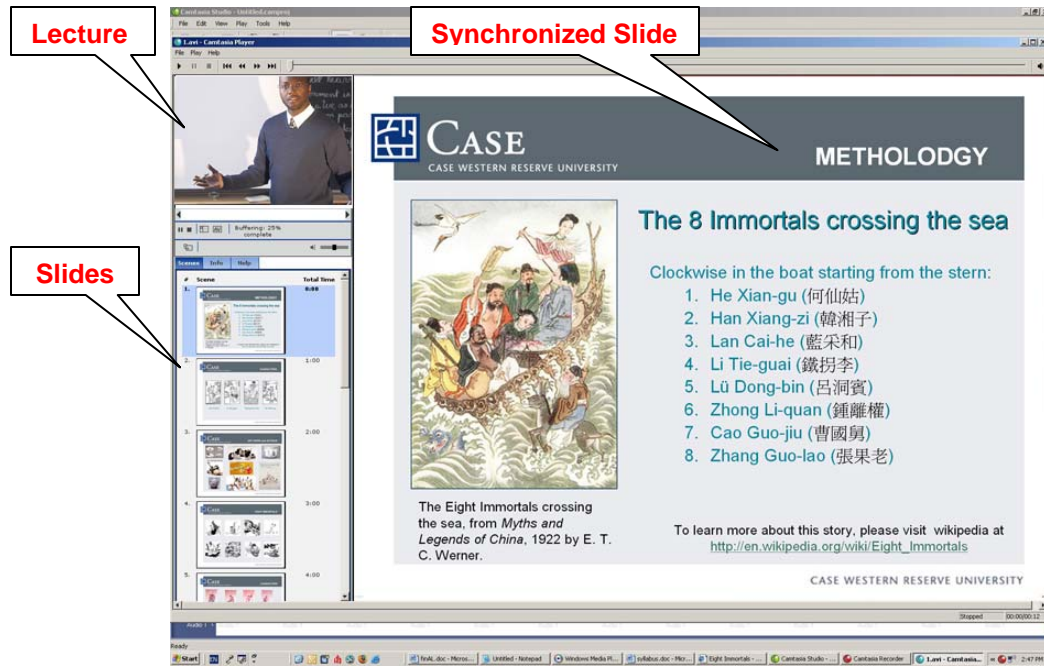


Figure 5: A sample of handout with matrix notes

Immortals in order	Nickname Characteristics	Chinese	Owned Tool	Tool Used
1. He Xianggu	Immortal Woman He	何仙姑	Lotus Flower	Lotus Flower
2. Han Xiang Zi	Philosopher Han Xiang	韓湘子	Flute (Bring everything to new live)	Flower Basket
3. Lan Caihe	Lan Caihe	藍采和	Flower Basket (Connect to the god)	Da Pi Ban
4. Li Tieguai	Iron-crutch Li (Alcoholic)	鐵拐李	bottle gourd (cure the illness)	Cane
5. Lü Dongbin	Lü Dongbin	呂洞賓	Sword (Control the bad spirits)	Flute
6. Zhongli Quan	Zhongli Quan.	鍾離權	Banana Fan (bring the dead to live)	Duster
7. Cao Guojiu	Royal Uncle Cao	曹國舅	Jade Ring (Environment cleaner)	Jade Ring
8. Zhang Guo Lao	Elder Zhang Guo	張果老	Fish Drum (Tell fortune)	Paper Donkey

Figure 6: Full-text story (About the story of “The Eight Immortals Crossing the Sea”)

The Eight Immortals crossing the sea is a story from *Myths and Legends of China*, 1922 by E. T. C. Werner. It is about eight immortals on their way to attend the Conference of the Magical Peach and encountered an ocean. Instead of going across by their clouds, Lü Dongbin suggested that together, they should use their powers (tools) to get across. These immortals have been friends for some time, and they sometimes exchange their magic tools for fun.

The first one to cross the ocean was Li Tieguai. He threw down his cane and it became a leaf-shaped canoe that floated on the water. Li Tieguai stands in the canoe and crossed the ocean successfully. Next, Zhongli Quan threw his Dusters into the sea, and while standing on it, he also successfully crossed. Zhang Guo Lao takes his time throwing his paper white donkey out, and rode the donkey across the sea. He Xiangu threw her lotus flower, and suddenly, the sharp red bright light is shining around the petals. She stands on the lotus pedals and floated to the opposite shore. Followed by He Xiangu, Lü Dongbin using his flute, and Han Xiang Zi his flower basket, Lan Caihe uses da ban pai, and Cao Guojiu using his jade ring, also went across the ocean.

The blatant use of powers by the immortals caused quite a stir in so The East Sea Dragon King dispatched a troop of shrimp and crab military to find out what happened and fight with these immortals. Then, because Lan Caihe was kidnapped by the East Sea Dragon King, the other immortals killed the Dragon King's son.

As if things aren't bad enough, soon The East Sea Dragon King asks help from North sea, South sea, and West sea Dragon Kings to deal with the Immortals. At this time, Cao Guojiu, uses his jade ring to create a road in the middle of the ocean. The water suddenly moves to two sides and all immortals escape the chaos. In the end, the Ru-Lai Buddha has to step in and put a stop to the fighting. Finally, Lan Caihe is released by the East Sea Dragon King.

Students are asked to use all available material to study this lecture before the second class. However, like normal college classes, this requires learning motivations and the self-regulated learning spirits to make the learning success possible. In this case, extra credit and gift certificate drawing opportunities will be offered for those who perform well in the exam that will take in place a week after the third lecture. Please note that students are asked to log their study experience. For example, when and how long do students in the experimental group viewed the videos? How many times the video is viewed? How long and how often do students in the control group study the lesson? What kind of materials do they use to study (handouts, PowerPoint slides, etc)? Do they preview the story before the first lecture?

Lecture Two – Story Telling

Since the purpose of this research is focused on “memorization”, the learning objective for this lecture is to help students be capable of narrating the story without any hints.

During the lecture, the instructor will emphasize the names and terminologies that were discussed in the first lecture while telling the story. The idea is to connect the new knowledge (story) with the knowledge that students have already known (information from the first lecture).

There is no handout for this lecture since students have already received a copy of the full story. Using the same procedures as the last time, students in the control group will receive a hard copy of the PowerPoint slides while the experimental group students will obtain a web link of lecture videos after the lecture. Please note that students in the experimental group will have access to both the first and the second lecture videos. At this stage, have the choice to watch either one of the videos or

both before the third lecture as many times as they wish. The students are also required to record their study log for this lecture before the next lecture.

Lecture Three – Graphics, Chinese Charters, and Art Worship

The focus of this lecture is to use “images” as mnemonics to enhance memorization and increase vocabulary communication. Two methods will be used in this lecture (1) Art (Painting) (2) Chinese characters. The learning objective for this lecture is that students would be able to identify the story charters from a picture and identify the Chinese characters that represent certain story characters.

During the lecture, the instructor will show several pictures with the eight immortals (Figure 7).

Figure 7: Sample of the Eight Immortals Art



The instructor would encourage students to discuss the picture. Ask students to identify the story characters on the picture and give their rationale about them. The purpose of this discussion is to connect student’s prior knowledge that they have received in the previous lectures and “provide a richer mental context and linking process increases the cognitive activity” (Joyce et. al., 2004). “Applications of both graphic organizers and knowledge maps can achieve impressive results in assisting the reader in memorization and comprehension of text content”. (Alverman, 1981; Lambiotte et al, 1984) In this case, Students are expected to use the acquired

attributes to define, distinguish, organize, and finally construct a meaningful cognitive map in their mind.

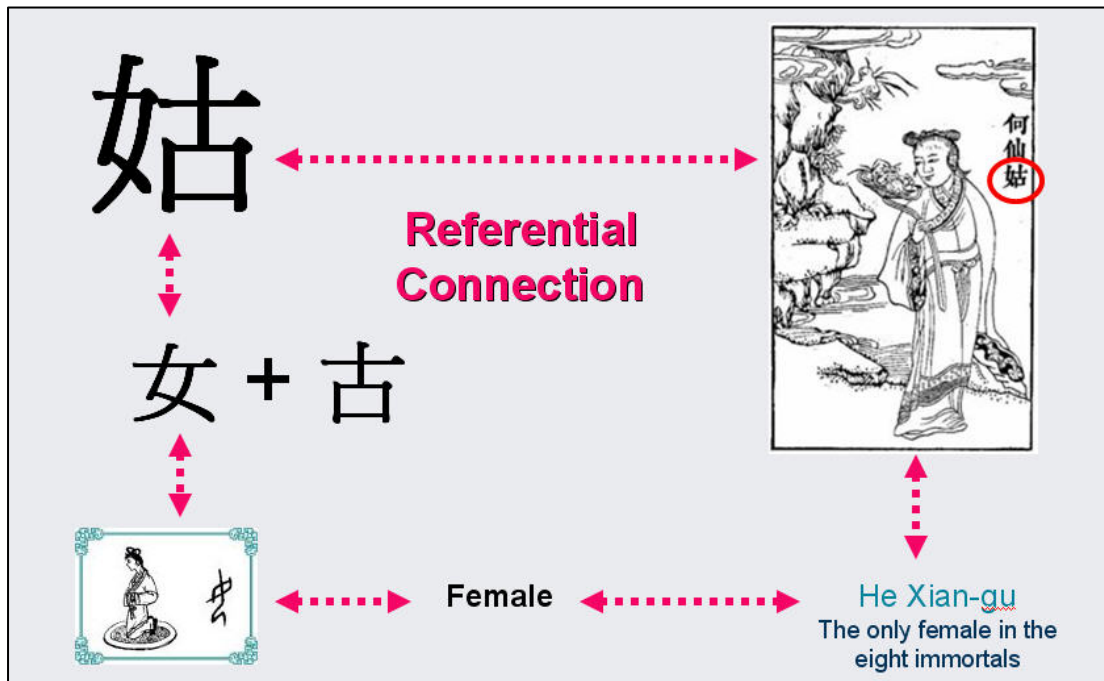
Another way to use “images” as mnemonics in this case is to introduce the Chinese characters and build its relationship with the story characters. Most of the Chinese characters are formed by the real objectives. Based on Wang and Thomas’s study (1992), image-based mnemonics (i.e., mnemonics describing and highlighting the visual aspects of Chinese characters) were superior for immediate recall than rote learning (Kuo and hopper, 1994). Also, logographs words provide graphic and semantic contexts that can lead to successful character recognition, even when the reader does not know the character’s etymology (Ke, 1996). Therefore, using the Chinese character image as a hint to connect with the character’s attributes in this case could be a good way to improve the memorization results in this case.

The purpose of this strategy is to build a “referential connection” by using “Chinese characters” as image-based mnemonics to recall the story character’s characteristics or vice versa. According to Kuo and Hoopers’ research (2004), generating one’s own relationship between a symbol and its meaning appears to be an effective strategy for remembering Chinese characters. I would like to extend the experiment by using the Chinese characters to generate a relationship between a meaning of a symbol (female) and a concept (the female immortal).

For example, the word “gu (姑)” in “He Xian-gu’s” name is a feminine word in Chinese. Therefore, the connection between the word “姑” and the concept of “He Xian-gu” is the only female can be easily linked. Also, the character “姑” is the combination of “女” and “古”. The word “女” means female, is transformed from the Oracle of a woman’s image. Another connection can be constructed between “女” and

“姑”, then from “姑” to “He Xian-gu” (Figure 8). Based on this pattern, students should be able to recognize any feminine Chinese characters. With this knowledge, they can now identify the word “gu” from the picture and remember “He Xian-gu” is a female. Since there is only one female in the eight immortals, students can identify the female characters among the immortals.

Figure 8: Referential Connection between the Chinese character and story character.



Dual coding is more likely to occur when the learning content is highly imageable, and better recall can be expected when information is dual coded, because two mental representations are more powerful than one (Kuo and Hooper, 2004). By connecting the Chinese characters with story concepts, it is assumed that students will be able to remember the story more effectively through the connection between Chinese characters to recall character’s characteristics or vice versa.

A week after the lecture, all participants are required to take an exam to evaluate how much they can remember about the lectures. The following areas will be tested –

- (1) Questions about the story – can students summarize the story?
- (2) Questions about the art work – can students identify the character in the picture?
- (3) Questions about the characters – Can students describe the story characters?
- (4) Questions about the tools – Can students match the tools with the characters?
- (5) Questions about the Chinese character – Can students identify the Chinese character with its meaning?

DATA ANALYSIS

I plan to

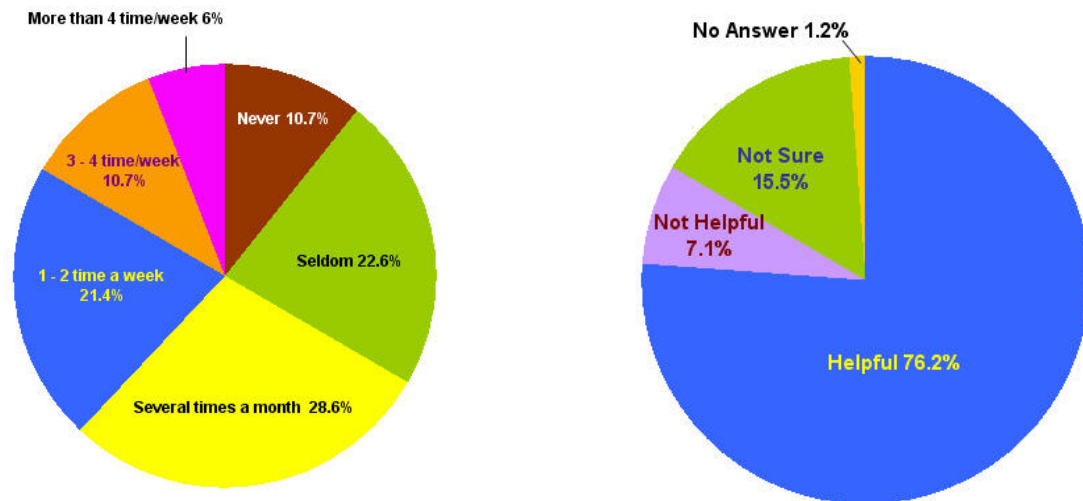
- (1) Compare the test results between the control and experimental group
- (2) Explore the relationship between the study activity log and student's performance within each group
- (3) Compare the high level students (who does well on the test) with their study behaviors, and see if there is any common study pattern is being recorded
- (4) Identify the questions are being answered correctly or incorrectly by the most of students, and discover the logic about it (if one type of knowledge can be remembered better than the other type)

RESULTS AND DISCUSSION

EXPERIMENT 1 - A total of 84 students participated in the first survey. The results (Figure 9) were as expected: 89.3% of the survey participants watched the video at least once this semester, and 38.1% watch the video at least once a week. On the other hand, only 23.8% of the survey participants do not think the application was

helpful. From this survey result we have learned that most students have viewed the lecture videos and 1/3 of them watch these videos at least once a week. More than 70% of the students find this technology helpful to their learning.

Figure 9: First Survey Results



Self- Regulated Learning and Self- Efficacy

Students actually self-regulate their learning by viewing the lecture videos voluntarily since it is not part of the course requirements. Self-regulated learning (SRL) involves the learners' intentional efforts to manage and direct complex learning activities (DuBois & Staley, 1997; Winne, 1995), which is a multidimensional construct that includes complex interactions among cognitive strategy use, motivation, and metacognition (Bulter & Winne, 1995; Perry, 2002; Schraw et al., 2002). The first survey result demonstrates the relationship between Self-Regulation Learning and this lecture video reviewing system.

The survey results indicate that students have strong beliefs in this technology, which generate strong motivations for them to watch videos often to achieve better

grades. Students need to be motivated to exert effort, to persist in the face to feel self-efficacy with their own accomplishments (Paris 2001). According to the previous SRL studies, self-efficacy has indirect influences on achievement through strategy use (Horn et al., 2003; Kauffman, 2004). Academic self-efficacy is a significant predictor of student achievement (Kauffman, 2004). Students with high self-efficacy achieve higher than do students with lower self-efficacy (Bruning & Horn 2000; Shell et al., 1989, 1995). From this study, we do not have any obvious evidence to prove that student's strong confidence in the courseware has any impact on student's memorization ability. However, the self-regulated learning behavior is obviously being observed in this case, which could be one of the possible elements to explain student's learning success.

EXPERIMENT2 – Since this is a proposed experiment, I do not have and study results to share at this time. My predictions for this experiment are (1) Overall, the experimental group does better on the test than the control group, (2) Students who do well on the test are the hard working students, (3) those who do well from the experimental group spent less time to study than the students who do well in the control group, (4) It is easier for students to identify the story character from a picture than from the Chinese characters, and (5) Most of the people can identify the character “姑”. Until the experiment is being implemented, I can not confirm whether the results match these predictions.

CONCLUSION

Memorization is such a powerful ability in human learning. My goal is to study the process of memorization, explore the techniques to engage better memorization quality, and integrate my discovery to design appropriate instructional strategies to create a high quality learning environment. Hopefully, by conducting the second

experiment in the future, it will lead me to the right direction toward to my ultimate goal.

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