Creating A Web-Based Online Flashcard for Korean Vocabulary Memorization

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Abstract— **The Korean language is one of the most enthused language these days, mainly caused by the Hallyu wave. In traditional language learning techniques, flashcards are often used to help memorize simple syllables. Nowadays, online flashcards are used as a replacement for the traditional flashcards, which are proven to be more effective in many ways. However, the lack of use of appropriate methods to learn a new language will result in slower learning process. Therefore, by implementing a suitable method such as the Leitner method to an online flashcard will improve the learning process. The Leitner method sets aside the questions that can be answered easily and allows users to focus on questions that cannot be recalled consistently by distributing a set of questions in five different sections. Every question that can be answered by the user is moved to the next compartment, where the question will be repeated after a specified period of time. System usability scale is used to measure the usability of the application. This application has been successfully designed and built using the Leitner method to give the user the suitable interval of time for learning with flashcards and achieved a system usability scale score of 82,5.**

Index Terms— **Leitner, Online flashcard, Laravel, Korean language.**

I. FOREWORD

To start learning a new foreign language, focusing on learning simple vocabularies is considered as a good way to learn blocks of sentences in order to improve skills of speaking in Korean [1]. One of the traditional ways to memorize vocabularies in a foreign language is to learn and repeat the characters periodically and see the visuals of the meaning of the foreign language so that it can be easily absorbed and remembered by using traditional flashcards [2].

In this era where technology has penetrated almost in all areas of the learning process, manual flashcards are no longer widely used. While technology was not superior, flashcards are used as a common practice to study by writing facts to be learned on a set of cards, which users see each card, think about the answer, then flip the card and take the next card. However, reviewing questions in manual flashcards is not effective because there are no specific guidelines to

decide when to review a particular question, and the learning process will consume more time [3].

Therefore, by applying the appropriate method such as the Leitner method to online flashcards can enhance the learning process. By using Leitner, if a question cannot be recalled by the user, the question will be repeated more frequently so that the question can be remembered faster. This method sets easily recalled questions aside from the difficult questions and allows users to focus on questions that can not be answered consistently [4].

Similar studies done by Agustyan Hidayat in "Design and Develop Spaced Repetition Software to Remember Japanese Characters using SM-2 Algorithm Based on IOS" and Jeremiah Daniel de la Rouviere in "Chinese Radicals in Spaced Repetition Systems: A Pilot Study on the Acquisition of Chinese Characters by Students Learning Chinese as a Foreign Language" by implementing the SuperMemo-2 algorithm. The difference between SuperMemo-2 algorithm and the Leitner method lies in the element determining the lag time for repetition [5]. The Leitner method uses a fixed variable to determine the lag time for the next repetition, whereas the SuperMemo-2 algorithm performs calculations made based on the performance of the user [6]. SuperMemo-2 may be able to boost learning efficiency, however the complexity of the calculations to determine the lag interval is considered too complicated and are more prone to errors when the scheduling is implemented into an application [7].

II. THEORETICAL BASIS

A. Korean Language

The Korean language is considered as one of the most enthused foreign language. Hallyu wave refers to the phenomenon of Korean entertainment and culture that are becoming more popular in the world with music, drama and film. The term was first coined by the Chinese media in the late 1990s to describe the increase in the popularity of Korean pop culture in China that boosts enthusiasm of the Korean language [8], but the cost to learn the Korean Language is fairly

costly, therefore some people have difficulties to learn words in Korean [9].

The Korean language has been around for thousands of years. Initially, they used Chinese characters to write the Korean language, called Hanja (한자). Hanja is not widely used to write in Korean anymore, but is still used in traditional and formal writings [10]. The words in the Korean language is represented by Hangul. Hangul is a phonemic writing system that consists of letters for consonants and vowels. Unlike the general phonetic writing systems such as Roman alphabet, Hangul is uniquely designed to combine consonants and vowels into units of syllables. Therefore, we can say that Hangul has something in common with syllabic writing systems [11].

B. Online Flashcard

According to Merriam-Webster, a flashcard is a card bearing words, numbers, or pictures that is briefly displayed usually as a learning aid. Flashcards are usually made using paper / cardboard and contains small text and images. There are eight main principles to make a good traditional flashcard [2].

1. The use of images. Studies revealed that the memory for pictures and simple texts are higher than the use of explanations using individual images [12]. The information presented orally and in writing are more memorable because the information presented with pictures can be ambiguous.

2. Create more flashcards to explain a scecific meaning. In order to maximize the learning outcome, create more flashcards using different explanations.

3. Use one question to explain one answer. If there is more than one answer to a question in a flashcard, the latter answers are easily forgotten than the first answer.

4. Prioritize the understanding. Users do not have to answer the same questions as those listed on a flashcard. If the user is able to answer with the synonyms of a certain answer, then the user has successfully answered the question.

5. Avoid the use of antonyms. The use of antonyms to explain questions are more prone to mistakes in recalling the correct answer.

6. Use straightforward and direct questions. Try to avoid a lengthy explanation and explain questions in short words that are easier to remember.

7. Use easy explanations. For explanations of a definition of a certain word, avoid sentences that are difficult to understand. Use annotations that can be remembered and understood easily.

8. Prevent the use of corections to study grammar To learn grammar, avoid using questions that ask the user to search for errors in a sentence as it will result in recollecting the wrong word.

The main advantage of learning using flashcars are direct feedbacks to find out if the answer right or wrong, and learning in small blocks so that learning process becomes effortless.

Flashcards are used as a common practice to write facts to learn at a set of cards, in which users see each card, think about the answer, then turn the card over and take the next card. But reviewing all the questions in a flashcard without a proper reference is considered less favorable because there are no guidelines to decide when to further review a particular question. Another problem is that the easy questions are repeated as often as difficult questions, resulting in the lack of reviewing difficult questions, and the learning process becomes less optimal because the time needed to learn takes up more time [3].

Online flashcards are designed to simulate traditional flashcards where two sections on the screen represent the front and the rear side of a flashcard [13]. The front side of the flashcard are questions in the form of texts, and the rear side of the flashcard are answers of the questions written on the front side. Online flashcards are designed to facilitate learning without the need to carry physical cards for studying a specific subject, which can help improve learning efficiency, accessibility and more interactivity, making the learning process stimulating. There are five main reasons to use online flashcards [14].

1. Easy access. Online flashcards can be accessed by using tablet PCs and smartphones, which are reachable compared to traditional flashcards.

2. Images can be added easily. Images can be found easily with the access of internet, so the drawing ability does not affect the image quality in a flashcard.

3. Reducing the use of paper. The use of online flashcards can help reduce paper usage and help save the environment.

4. Flashcards can be shared easily. Flashcard can be shared easily to others by sharing among social media.

5. Saves time. Online flashcards are made easier and more accessible, so that the time used to revise flashcard be maximum and learning outcomes can be improved.

C. Spaced Repetition System

According to Rehana Mubarak in the publication entitled "Spacing Effect and Mnemonic Strategies: A

Theory-Based Approach to e-Learning", the process of learning can be more effective if the informations are repeated in different intervals, where difficultly recalled questions are repeated in a shorter time interval and easily recalled questions reviewed again in a Moment [15].

Ebbinghaus concludes that a person is able to remember 100 percent of an information upon receiving the question. Thereon, the information is forgotten promptly. In merely 20 minutes, 42 percent of what has been learned are forgotten, and in 24 hours, 67 percent of the information is lost from memory. In the end, after a month, a person is only able to remember 21 percent from the information that has been memorized [16]. The forgetting curve shows a decrease of retention in the long run, where information will be lost if it is not recalled again [17].

Spaced repetition system is a learning technique used by combining the interval of interval time between repetition of the previously learned material to develop a psychological spacing effect into codes that can be implemented in an application. Spaced repetition are commonly used ina contect where a person needs to study a large amount of information and make sure the informations can retained in the memory. Spaced repetition system is suitable to use in terms of learning vocabulary in a foreign language [18].

D. Leitner method

The Leitner Method was developed by Sebastian Leitner in the 1970s with the aim to improve the efficiency and effectiveness of learning. The traditional Leitner method divides questions into five different compartments. The main process of the Leitner method can be described in Fig 1 below.
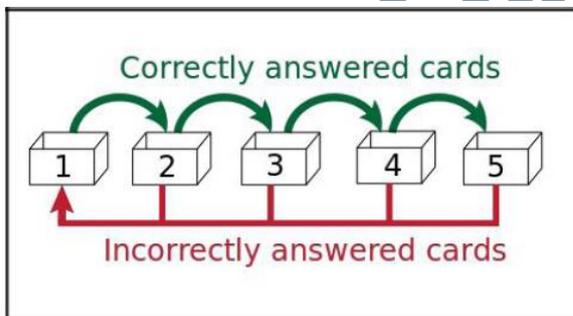

Fig 1. The Leitner Method [3]

All flashcards starts from the first deck (Stack 1) is regarded as a question that was never reviewed, and it is assumed that the question in the first stack is the hardest, so that these questions need to be addressed in a short time so that the answers are easier to remember. When reviewing the flashcards, all correct answers will be moved to the next deck, because the answers were considered easier to remember by the user. This process is repeated until the last deck, and if there are questions that are not recalled by the user, the

flashcard is moved back to the first compartment, since the question is considered to be forgotten and needs to be reviewed again in a short period of time so that the answers can be remembered easily. The key to the efficiency and effectiveness of the Leitner system is that a card that is in the lowest deck would be more frequently reviewed than the cards that are in the highest deck. This method sets aside the questions that can be answered easily and allows users to focus on questions that cannot be answered consistently [4].

The main concept in the Leitner method is to study the information within a specified time. At the beginning of the learning process, all the flashcards start from level 1. The Leitner Schedule used for this application is a loop within 16 days to determine how often to repeat the information in a different box for five different compartments [19].

Table 1. Standard time settings for the Leitner method

Level	Time required for the next occurence
1	0 days
2	1 day
3	3 days
4	7 days
5	15 days

Table 2. Utilization of determining the level for 16 days

Day	Level	Day	Level
	1,2	9	1,2
2	1,3	10	1,3
3	1,2	11	1,2
4	1,4	12	1, 5
5	1,2	13	1,2,4
6	1,3	14	1,3
7	1,2	15	1,2
8	1	16	1

Table 1 is the default setting for the Leitner method, and the utilization of determining the level for sixteen (16) days are shown in Table 2 [19]. The use of the Leitner method has many advantages. The Leitner method users can learn words in a short time unit and are able to study according to the user's memory. The main advantage of this method is that users are able to focus on flashcards that are more difficult to remember, which results is a reduction in the amount of time it takes to learn a subject. This method will provide maximum learning results if the learning process is done every day and interspersed

with a short break after studying for 45 to 60 minutes [20].

E. *System Usability Scale*

System Usability Scale (SUS) is a series of questions to the questionnaire prepared by John Brooke in 1986 to collect data to evaluate a wide range of products and services, including hardware, software, mobile devices, websites and applications and other media [21]. SUS is part of the ISO 9241 standard, which ISO defines usability [22]. SUS consists of ten questions in a questionnaire with five answer options to respondents that varies from strongly agree to strongly disagree and are represented in the form of the numbers one through five [23]. SUS has become the industry standard, with more than 1300 references in articles and publications. The main benefit of using SUS to scale usability of an application is that the scale of response is easily understood by the participants of the questionnaire, and also that it can be used in small samples with reliable results. SUS results can distinguish between systems that can be used and cannot be used [24]. Calculation of votes for the SUS is as follows [25].

1. Odd-numbered items: subtract one from the user response.

2. Even-numbered items: subtract the user responses from 5 points

3. Add up the converted responses for each user and multiply that total by 2.5. This converts the range of possible values from 0 to 100 instead of from 0 to 40.

Based on the results from 500 different evaluation studied by Jeff Sauro, the average value for SUS is 68 points. If the value is more than 80.3 points, then the system is considered as an excellent system. If the value of SUS is higher than 68, then the system is considered above average. If the value of SUS below 51, then the system is not considered good enough and less in accordance with the standard and changes in the system are necessary to increase the value of the SUS [26]. One advantage of using SUS as a measurement of the degree of usefulness of the application is the minimum amount to get the SUS points is relatively small, with fifteen users [27].

III. SYSTEM DESIGN AND ANALYSIS

The following are the research method implemented in this paper.

1. Literature review, a process in which a study of sources such as journals, reports, applications, web pages, or articles that have been published by other researchers about Leither, flashcards, online flashcards, spaced repetition systems, and others are studied.

2. Application design, a process in which the application algorighms are designed to ease the app making process.

3. Application implementation, a process which implements the algorithm and design that was made in the code to build a web-based online flashcard application.

4. Survey, a process which conducts a survey to ensure product quality from the user's perspective so that the application can be used as a medium of learning the Korean language which are interactive and easy to use.

5. Create reports, a process in which a report is made to summarize the process of creating the application as well as the conclusions of the research.

A. *Flowchart*

Fig 2 shows the flowchart used to determine the level by implementing the Leitner method.
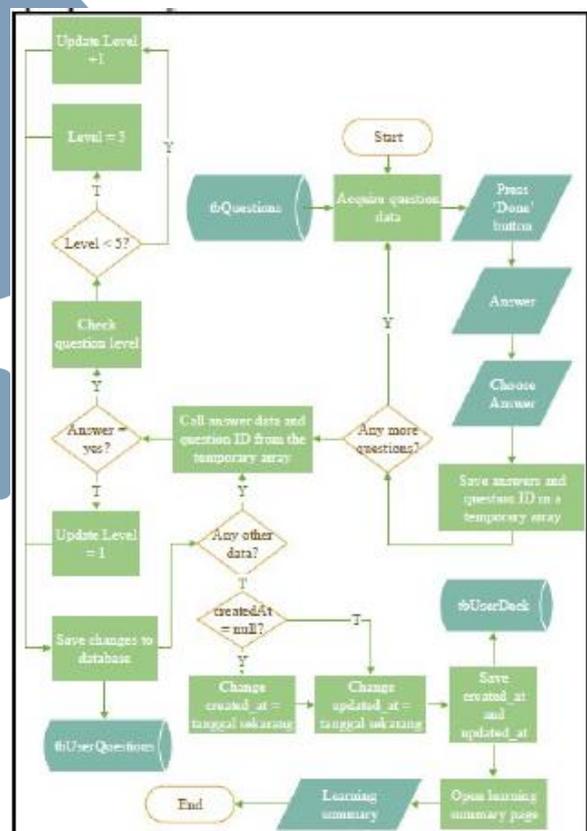

Fig 2. Leitner learning process

B. *Entity Relationship Diagram*

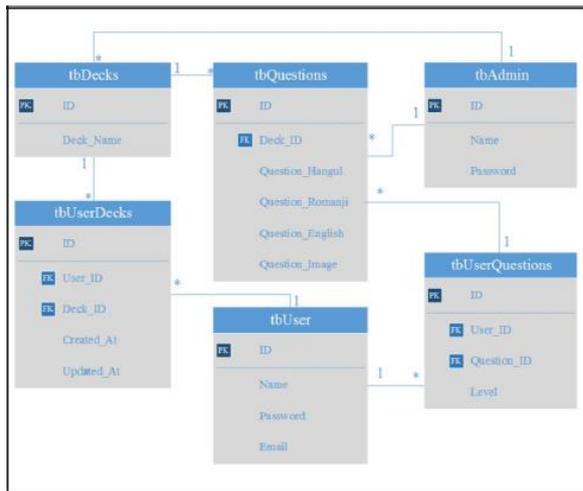Fig 3 shows the Entity Relationship Diagram created for the application.

Fig 3. Flashcard application ERD

IV. TESTING AND IMPLEMENTATION

Application testings are commenced so that the application made is in accordance to the main purpose of making this application.

This test measures the user satisfaction levels when using this application to learn the Korean language. The questions used in this application is according to the System Usabilty Scale (SUS) and the results are taken from five different respondents to obtain an average value for the application. Table 3 shows the calculation results with SUS for the first version of the application from a perspective of five users.

Table 3. First respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	3	5	4	3	4
Q2	2	3	3	2	3
Q3	4	4	4	4	4
Q4	2	3	5	3	3
Q5	4	5	4	3	4
Q6	4	4	1	3	2
Q7	5	3	1	4	5
Q8	1	1	1	1	2
Q9	4	3	3	3	4
Q10	5	5	4	4	3
SUS score	65	60	60	60	70
Average SUS score	63,0				

As a result of low average yield score from the five respondents who have used the application for the first time, the application received an unsatisfacory value of SUS of 63.0 points, therefore a few changes were made for the application. Tutorials were added before the learning process begin to ensure users understand how to learn the application properly. Table 4 shows the calculation results with SUS for the second version of the application from a perspective of five users.

Table 4. Second respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	4	5	4	3	4
Q2	2	2	2	2	2
Q3	4	4	5	4	4
Q4	2	2	5	3	2
Q5	4	3	5	3	4
Q6	1	2	1	2	2
Q7	4	4	5	5	5
Q8	2	1	1	1	2
Q9	4	4	4	4	4
Q10	3	2	3	2	2
SUS score	75	77,5	77,5	72,5	77,5
Average SUS score	76,0				

Based on the average yield of the five respondents who have used the application for the second time, the SUS value obtained is quite satisfying. The SUS score obtained for the second version of the application is 76.0 points. Some minor changes in the application is made again to boost the value of SUS. The changes made are modifications to the application's layout for an orderly interface, adding links to the learning progress page after each category is completed, and the addition of the 'About', 'Credits' and 'Help' menus for an explanation regarding the application and the addition of the 'Tutorial' menu on the category selection page.

Table 5 shows the calculation results with SUS for the third version of the application from a perspective of five users.

Table 5. Third respondents results

Question no.	Respondents				
	P1	P2	P3	P4	P5
Q1	4	5	4	4	4
Q2	2	2	2	2	2
Q3	5	4	5	4	4
Q4	2	2	2	1	1
Q5	5	4	4	4	4
Q6	1	1	1	1	1
Q7	5	5	5	5	5
Q8	1	1	1	1	2
Q9	5	4	3	5	5
Q10	2	2	1	1	1
SUS score	90	85	85	90	87,5
Average SUS score	87,5				

Based on the average yield of the five respondents, the SUS value obtained is satisfying. The SUS score obtained for the third version of the application is 87.5 points.

V. CONCLUSION AND FUTURE WORKS

The final conclusion is that the web-based application used to memorize the Korean language was successfully designed by implementing the Leitner method. The application has been successfully constructed by implementing the Leitner method to determine the repetition interval for each questions. The application has managed to produce a dynamic interval where each users can obtain a different learning interval so that the application can adapt according to each users and has obtained a satisfying system usability scale score of 87,5 points. Further suggestions for the inprovement of the application is to improve the learning system in terms of an addition to the learning features to determine the learning process when a user skips a day of learning so that the learning process corresponds to the Leitner method by adding the questions from the skipped days to the day the user opens the application. improvements can also be made to enhance the user interface so that the learning process can be more appealing and can help motivate the learning process by using the application. In addition, a sound output can also be added to each flashcards to learn the pronounciation of each words.

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