Design and Implementation of Repeatable and Short-spanned m-Learning Model for English Listening and Comprehension Mobile Digital Textbook Contents on Smartphone

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Abstract

As information society matures to an even higher level and as information technology becomes a necessity to our everyday lives, the needs to develop, support and satisfy personal and social needs without the limitation of time, space, and location have become a vital point to everyday lives. Smartphone users are increasing at a staggering rate but the research on mobile-Learning model and the implementation of m-Learning scenario are still behind the needs of the users. Therefore, this paper focuses on the design of 'repeatable and short-spanned m-Learning model' to meet the needs of the learners who are on the go and on the move with their smartphones. Smartphone users frequently reach out for their phones but compare to the frequencies, the actual span of time they spend per use are relatively and surprisingly short. One way to understand this phenomenon is that the users tend to immediately replace their smartphones with laptops or desktops whenever they are available. A leaning model was needed to reflect this short and frequent use, a use that is solely based on the smartphone environment.

This proposed learning model first defines this particular setting and implements the model to real smartphone users over an 8 week period. To understand whether different learning backgrounds can influence this model, different schools with online and offline learning channels participated in the experiment. User survey was conducted after the experiment to get

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a better understanding of the smartphone users. Pretest and posttest were conducted before and after the experiment and the data were validated and analyzed using SPSS version 18.0 for PC. Preliminary descriptive statistics, multiple regression and cross validation was conducted for the analysis. The results showed that the proposed English Listening and Comprehension Mobile Digital Textbook (ELCMDT) had a positive effect on the learners in general and was more effective for learners who were already experienced with online learning.

Keywords: m-Learning, m-Learning Model, English Listening and Comprehension Mobile Digital Textbook Contents, Smartphone, online education

1. Introduction

M-Learning, e-Learning, and u-Learning (Ubiquitous Learning) with increasing capacity of mobile networks and computing powers are searching the next stage in learning contents. The importance and effectiveness have been reported on various papers and surveys, however specific educational contents on the smartphone or usability on the students are if any, very few at this incipient stage. To develop a learning content that embodies such changes and needs, this research first designed a new model for the smartphone users and then implemented the design to college English learners. To see whether previous learning background or familiarity of online learning can influence the overall outcome, students from both online and offline colleges participated in the experiment.

This research specifically aimed to look at the effects of smartphone lessons with specific tasks on English listening skills. Usable and practical listening contents and instructional designs specifically designed for the short span smart phone environment were implemented and tested. Previous researches only introduced the methodological approaches or concentrated on the phenomenon of u and m-learning without the real implementation of the services. Thus, experiment on users themselves with concrete data were lacking compared to the elaboration on the history or the need analysis of the personalized learning environment. The need for real user experiment and the analysis of the various factors involved in this particular learning environment were necessary at this stage.

The purpose of the study is to first propose an effective instructional design and learner model for English listening skills under the m-Learning environment with smartphones. The design was based on constructivism, context-aware learning, and self-directed learning. Then to further improve the design, any influences the students' level of studies or previous online experiences can have on the experiment were tested and analyzed. All the students were able to participate in this study with the Android application.

2. Literature Review

2.1. M-Learning Environment

Previous researches on m-learning environment focus on the following two topics; first the need, and second the effectiveness of mobile device learning. First, research [1, 2] looked into the use of mobile devices as the learning channel for 1,500 Korean students. The results concluded that mobile phones proved to be the most popular device among the students. When learning English in particular, PC type devices were still the most frequent devices to be used however, participants who already had a mobile device learning experience answered that mobile phones were the most effective in improving listening skills than other devices [1, 2]. [3] looked at the determinants that influence English mobile-learning by giving six variables; ubiquity, mobility, self-directed learning, perceived usefulness, perceived ease of use, and behavioral intention, to total of 212 users and concluded that all of the variables had a valid enough reason to work as a determinant. Further, Song et al. looked into the effect of m-Learning environment on perceived usefulness, satisfaction and performance in English learning from 700 surveys [2]. The result supported the tested hypotheses, with the exception of the casual relationship between interactivity, that perceived usefulness and performance in English learnings were valid in the m-Learning environment.

Longitudinal research was also conducted in the use of mobile phones and Computer Assisted Language Learning (CALL) [4]. This research was conducted for three years and conclusion was made that learner's life style and learning style were a key factor in the progress and development for the learners when using such devices. Direct mobile device learning was also conducted by several researches. First, effective use and preferences of mobile English learning was conducted in research [5]. University students in Japan were given 100 new vocabularies on a week interval through their mobile phones and 93% felt that this was a valuable teaching method with 71% preferring to receive these lessons on mobile phones rather than on PCs. Second, Short Message Service (SMS) were used to support language, particularly vocabulary learning, for Italian beginners in Australia by [6]. Their experiment found that students appreciated the overall experience, yet had wide range of views on the frequency of messages being sent to the students. Similar research was also conducted in Taiwan where experimental and control group were given vocabulary lessons, former via SMS and the latter through the conventional paper method [5]. Research findings showed positive results toward the experimental group. These groups recognized more vocabulary than the traditional paper based learning.

Overall, previous researches showed positive feedbacks and results from the users within the m-Learning environment.

2.2. Self-Directed Learning

Based on constructivism, where the learner takes the center stage and self-directs to create new knowledge from prior experience, [7] looked extensively for examples and uses of such learning from China's Smart Classroom to Spain's Ubiquitous Learning Appliance. This paper took preliminary survey from 61 college students taking English courses to develop the u-Learning oriented model on English learning. The results showed that although respondents didn't yet abide in a u-Learning environment at school or at home, but were already ready and aware of the advantages [7].

In line with this paper, self-directed learning was also researched by [8] at an English Language Center at Dahran, Saudi Arabia, which also included a qualitative study on the value of self-directed learning. Several useful finding were yielded from this research. First, second language learners expressed a positive attitude towards self-directed learning. This finding was possible through background interview and questions that followed. The questions where geared to finding out how learners perceived Self-Directed Language Learning (SDLL); 1) What English language skills improved more through SDLL?, 2) What benefits were received from SDLL orientation in this center?, and so forth. Second, learners' involvement and self-directed projects proved to be helpful in gaining confidence not only in their learning ability but also in managing their own learning. This also proved to be helpful in becoming independent language learners. Moreover, the research suggested the importance for educators to provide the framework onto which learners can gradually graft their own experiences as they progressively become self-directed learners.

2.3. Short-Term Cycle Repetition m-learning Model

Repeated listening or extensive listening strategy has been an on-going debate in English education. How and what is more effective for L2 students have been researched extensively for some time. However, in a 'self-directed learning environment' where the learners take control of the amount and intensity of the listening input, repeated listening with fewer amount of texts and lesser difficulty can work better. 'Repeated input' or 'repeated listening' have been an effective strategy for L2 learners and as [9] states "students reported that they kept revising

their comprehension by listening three times as an effective strategy, and they told themselves not to be nervous because they knew they had three chances to listen to the input" [9].

This clearly shows that L2 learners of English will be able to take their learning strategy in full only when they are able to know that repeated listening is possible and guaranteed [8, 9, 10]. This is closely connected with the next learning theory that was one of the bases for this model; the 'Anxiety Reduce Factor' [7]. 'Anxiety reduce factor', or the 'Affective Filter Hypothesis' propose that affective filters and learning developments have a reverse effect on each other [11]. Paper [11] researched on the accounts on how affective variables influence the process of L2 learning and concluded that listening experiences that can lessen the students' anxiety will generally be beneficial to the learners.

In paper [12] and [13], effects of repeated listening are continuously referred back with short term memory and the short term cycle learning. First, short-term cycle in regards to short-term memory has been researched by a phonological short-term memory study and the effective use on adult learners on paper [12]. Recent findings have also proven that in addition to repeated learning, repeated testing while learning enhanced the learning process and in turn increased the long-term retention for the learners [13].

2.4. Listening Strategy

When designing the contents for this research, several important concepts on effective learning were put into effect. First and foremost, relevant and authentic listening texts and materials were taken into account. This has also been applied to the instructional design, strategy training, and subtitles of the contents.

Paper [14] states that "human cognition has a single goal in which we pay attention only to information which seem to us relevant". And in relation to this research, [11] gives relevance as one of the teaching principles and explains that learning materials are relevant when they relate to the learner's goal and interest, and when they can involve self-selection and evaluation. Paper [11] also states that in teaching listening, the most important aspect is the selection and use of the input. And this is followed by whether the input can introduce authentic language. Authenticity is summarized as "the most controversial issues in the teaching of listening and at one end of the spectrum are those who define authenticity as any and all language that has been actually used by native speakers for any real purposes" [11].

As important as it is, authentic listening materials are not always feasible, and thus 'genuineness' is proposed in paper [15]. Since, 'authentic' input is quite impossible for the 2nd language learners to deal with, genuineness comes close to how inputs should be made in listening inputs. As [11] puts it "language input should aim to be genuine, i.e. involving features of naturally occurring language with and between native speakers: speed, rhythm, intonation, pausing, idea density and so forth". And therefore, 'genuineness' is the more practical and usable 'authenticity' for the listening inputs. 'Unlike 'genuineness', authentic input is "impossible for the instructor to provide" [11], therefore, genuine yet manageable and usable input was used in this experiment. To achieve genuineness, paper [11] suggested several designing points. First, tasks should be able to preview key vocabulary and discourse structures. Second, inputs should be chunked into manageable segments. Third, focus should be made on selective and particular elements. By paying caution to such elements, the instructors can transform authentic materials into genuine and manageable input, which can in turn motive the learners in all levels of learning [11].

2.5. Summary

Previous findings and learning models look very promising for mobile learning. However, data

[1] revealed that among 1199 university students in Korea, nearly 60% were not using their smartphones as their learning devices. 42% of the students felt that there was a lack of learning contents as a whole and 16% simply did not know 'how' to utilize their smartphones as a learning device. Therefore this experiment merged the demand of mobile learning and the short term learning model. Repeated listening is a generally established model in m-learning environment, however, of how much and what to put into the actual input were not collaborated in the previous models. Repetition and short-term cycle with the m-Learning model were also not incorporated, and to examine the variables that influence this outcome would also be useful for future studies. In summary, creating and utilizing the 'right content' with the 'right device' could lead to an interesting and useful findings for the smartphone learners.

3. Method

3.1. Participants

The research had total of 42 college participants from 4 different schools. To compare the differences among online and offline channel of learning, participants were divided into two groups. **Table 1** and **Table 2** display the specifics of the participants. First, the number of the participants and the schools are displayed on **Table 1**. The percentage of online versus offline learning is displayed on **Table 2**. Offline line students have taken a slightly active role in the experiment.

Table 1. Number of Participants

Groups	F	%
K U.	12	28.6
O U.	13	31.0
S U.	8	19.0
C U.	9	21.4
Total	42	100.0

Table 2. On-line and Off-line

Groups	F	%
On-line	22	52.4
Off-line	20	47.6
Total	42	100.0

3.2. Instruments

This part of the paper describes the learner model based on the previous findings and theories. Actual design and the instructional model used for this experiment will be displayed and explained with actual images.

3.2. 1. Short Term Cycle Repetition Model

The details of the Short Term Cycle Repetition Model (STCRM) are shown on **Fig. 1**. The actual smartphone experiment also followed this step by step guide and moved from the first, "Target Goal Presented" to the "Summary and Reflection". The phases or the step by step guides are explained in Table 3. This table elaborates on the target goals for both the instructor and the learner. With the target goals, strategies used for English listening are explained for each phase.

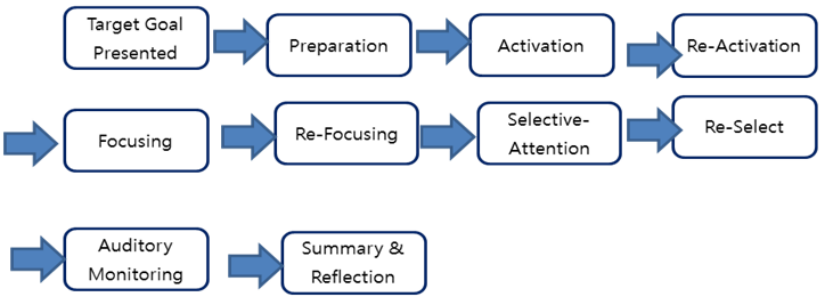

Fig. 1. Short Term Cycle Repetition Model (STCRM)

Table 3. Target Goals and Strategies of STCRM

Phase	Instructor's Side	Learner's Side
Target Goal Presentation Phase	The goal or the theme of the lesson is presented to stimulate and activate prior knowledge. Direct attention to the topic is made.	Learners' prior knowledge is simulated by the target goal presentation.
Preparation Phase	Key expressions are presented visually to reduce learner anxiety.	Learners' predict listening strategy is activated by the visual presentation of the key expressions and the settings of the lesson.
Activation Phase	Various listening exercises are presented to active various listening strategies including predicting, inference, and monitoring skills.	Learners can focus on the key expressions and aural presentation of the related expressions can activate the learning process.
Reactivation Phase	Second listening text with similar structure is presented to activate the learners' reactive strategy.	Learners can relate and compare between the first and the second listening tasks. Relate and compare can simulate the reactive strategy.
Focusing Phase	True or False questions are presented to activate cognitive strategy.	Learners use cognitive strategy and listening strategy to solve the true or false questions.
Re-focusing Phase	Gap filling tasks are presented to let the learners' refocus on the listening patterns.	Learners can refocus on the form of the expression with the gap filling tasks.
Selective Attention Phase	Connected speech patterns such as assimilation, reduction and elision are presented to teach phonotactic strategies in listening.	Learners can acquire and experience the phonotactic strategies in English listening.
Re-selecting Phase	Similar contexts are presented to exemplify the phonotactic strategies.	Learners can identify the phonotactic strategies with real examples.
Auditory Monitoring Phase	Questions are presented for auditory purposes. Ideal or model answers are presented to simulate the monitoring strategy.	Learners have the chance to self-respond to the questions. Model answers can help the learners' monitoring and auditory strategies.
Summary and Reflection Phase	Final follow up listening is presented to provide the learners with the reflection phase.	Learners can reflect and summarize the key expressions from this unit.

3.2. 2. Instructional Design

'Repeated learning to reduce anxiety' is the focal point of this design and therefore the following two points were the main focus in designing the instructional model. First, the lesson had to be short in both terms of per page and per lesson content. In anytime and anywhere environment, short span for smartphone uses were inevitable, therefore the lesson had to be short yet condensed. The lessons in this model are no longer than 10 minutes per unit. Lesson per page was also shortened to accommodate the smartphone users' consistent move. Quick yet concentrated listening skills per page were adapted to the model. Second, in such environment, application shouldn't be complicated. Simple and user friendly applications and easy download frames were applied. This is coined as the 'cycled' model or the 'cycled' frame.

The lesson plan and the contents are shown in the following figures from **Fig. 2** to **Fig. 17**. Each figure has the lesson plan on the left and the captured image on the right. The smart phone images are the actual lessons the students experimented with. The first main page with the weekly plans and the lesson theme are displayed in **Fig. 2**. Pre-listening activities are next introduced in **Fig. 3**.

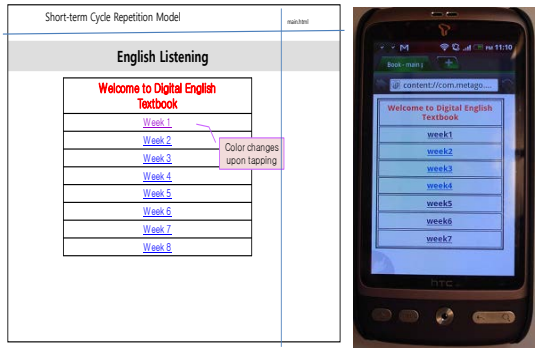

Fig. 2. Table of Contents

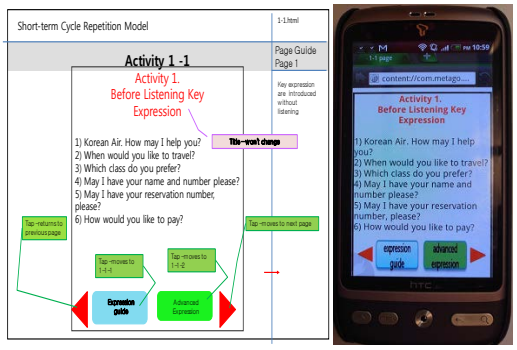

Fig. 3. Pre-Listening Activity with Key Expressions

Fig. 4 shows the key expressions both in English and Korean to help the learners' understanding. Key expressions are expanded with new sentences in **Fig. 5**.

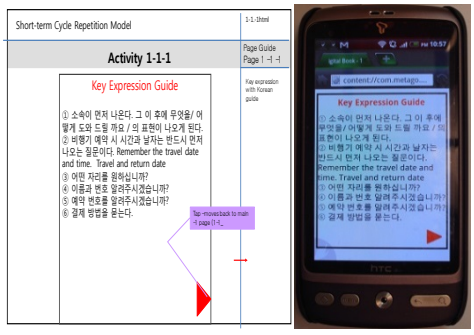

Fig. 4. Key Expression Guide

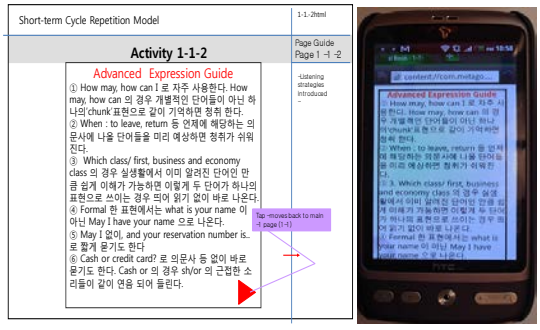

Fig. 5. Advanced Expression Guide

The following exercises from **Fig. 6** to **Fig. 9** follow the activation and focusing phases from the previous STCRM described on **Table 3**. Listening comprehension task with true or false questions are introduced in **Fig. 6**. This is followed by the answer guide in **Fig. 7**. The true or false tasks are further explained in **Fig. 8**. Gap filling tasks to activate and refocus on

the key listening patterns are displayed in **Fig. 9**.

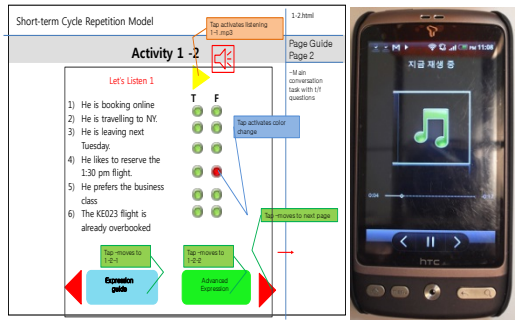

Fig. 6. Listening Comprehension Task

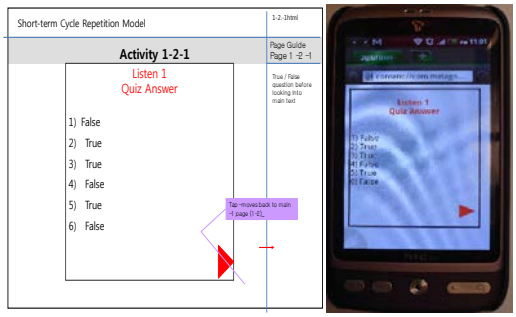

Fig. 7. Task Answer Guide

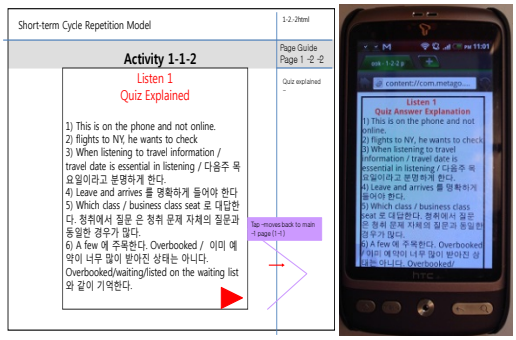

Fig. 8. Quiz Guide

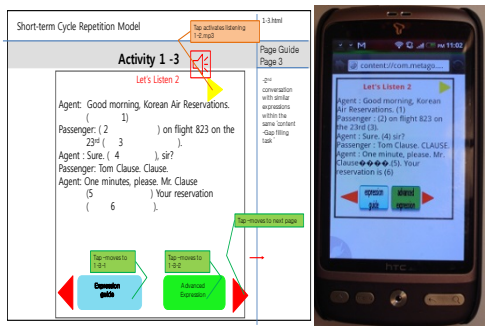

Fig. 9. Gap Filling Task

This is followed by the gap filling guide on **Fig. 10**. Listening skills and strategies are introduced from **Fig. 11** to **Fig. 15**. Phonotactic strategies are explained in **Fig. 11**. This is followed by the listening exercises on **Fig. 12**. Another set of listening tasks are introduced in **Fig. 13**. Aural inputs are displayed with visual inputs to activate simultaneous learning strategy. Third listening text with sentence by sentence guide is introduced in **Fig. 14**. Final listening clinic guide with key expressions are displayed in **Fig. 15**.

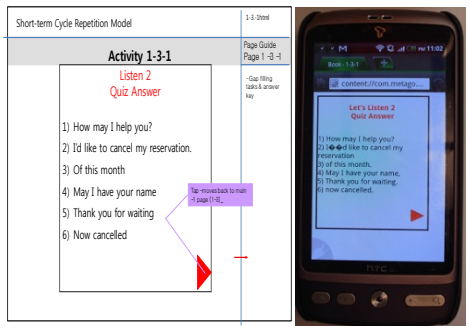

Fig. 10. Gap Filling Task Guide

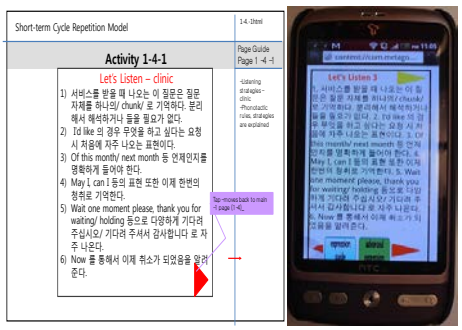

Fig. 11. Listening Clinic

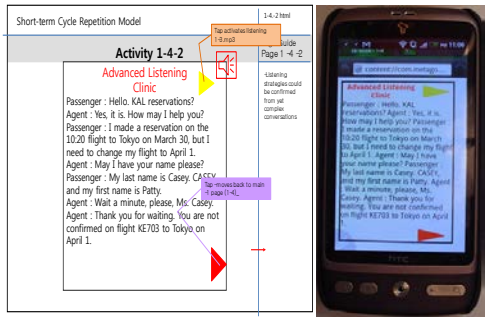

Fig. 12. Advanced Listening Clinic

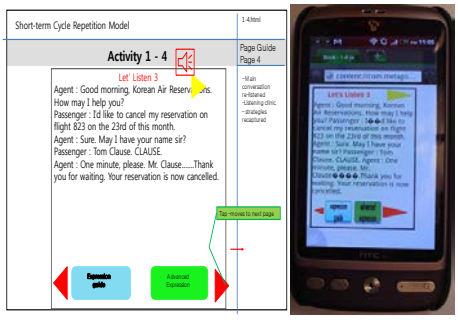

Fig. 13. Listening Activity Two

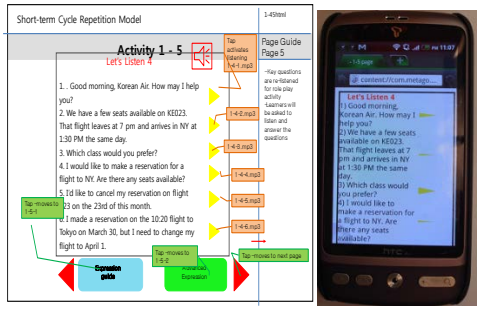

Fig. 14. Listening Activity Three with Tasks

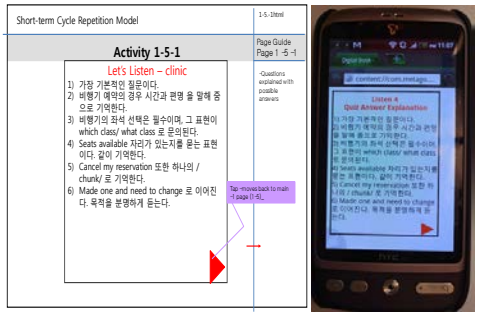

Fig. 15. Listening Clinic Page

Final listening comprehension task with answers are shown in **Fig. 16**. Finally, the summary page with overview guidance is given in **Fig. 17**.

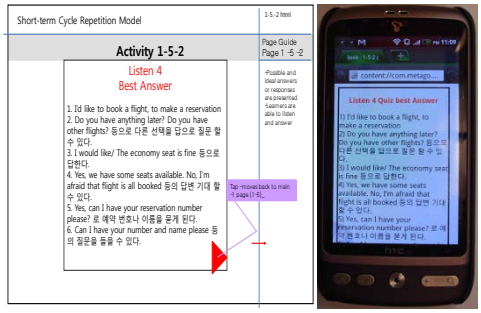

Fig. 16. Answer Guide

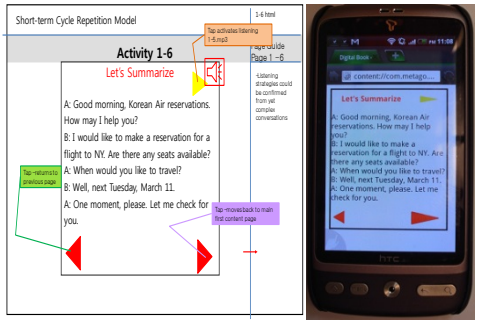

Fig. 17. Weekly Summary Page

3.3. Data Collection and Testing Procedures

Pretest and posttest were conducted after 3 months interval. Right after the pretest, the learning content which consisted of an 8-week long learning process was directly downloaded by the students via their emails. Although the contents were originally designed for an eight week lesson, to avoid any washback effect and to provide sufficient amount of time to practice and acquire the new learning application, posttest was conducted after 3 months interval.

One passage one item principle was secured on the test items to abide with the Test Method Facet (TMF), to guarantee local independence and to include a wide variety of topics [16, 17]. “To enhance interactions by reflecting the natural cognitive process activated in real-life

communication" [16], the following elements were reflected on both tests. First, the questions' speed abided with the natural speed in spoken language (160-190 WPM). Second, whenever possible, spoken language was presented on the tests, however due to technical difficulties, choices were displayed visually than aurally. Third, exposure sequences aimed to reflect the natural cognitive process by following the macro to micro listening stages. Also in order to reflect the natural process, listening passages were heard twice. Ideally, questions and choices should only be given through aural inputs however, since most of the students were only familiar with the visual choices, to avoid any difficulties, choices and prompts were displayed in advance.

3.4. Analysis

SPSS version 18.0 for PC was used for computing descriptive statistics, multiple regression and cross validation for the analysis. Descriptive statistics analyzed the score differences between the pretest and the posttest scores on an individual, school, and group levels gain scores. Multiple regression was performed to identify whether the variables involved in this research influenced the score changes. Finally, cross validation was performed using the Decision Tree Procedure to further access how the results of the statistical analysis can generalize from this particular data set.

4. Results

In this part of the paper, the results of the study are presented through tables and figures, and then discussed in details. The findings are divided into three parts: the preliminary statistics, regression and the tree-based classification analysis.

4.1. Descriptive Statistics

First, three groups were divided according to their test scores. With the three groups, comparisons were made according to the different schools and whether they were taught online of offline. To view the range according to the scores, pretest percentile rank was calculated on **Table 4**. Tukey's test was applied to divide the range with lowest 25% range gaining 9 points, mid-range from 10 to 15 and higher range of 25% at more than 16 points.

Table 4. Percentile Rank

		Percentile Rank						
		5	10	25	50	75	90	95
Weighted Average	Pretest	5.45	8.00	9.00	12.00	15.25	17.00	18.00
Tukey's Hinges	Pretest			9.00	12.00	15.00		

To see any significance or differences between the gains of the participants of online and offline students, first differences between the pretest scores were needed to be compared at **Table 5**. T-test was used to compare the differences and using one-way ANOVA, pretest score differences among 4 schools were compared at **Table 6**.

Table 5. Descriptive Data for the Pretest Scores

Groups	N	Mean	Standard Deviation	T score
On-line	22	12.73	3.561	0726
Off-line	20	12.70	3.715	

Table 6. ANOVA for the Pretest Scores

Groups	N	pretest mean	F score
K U	12	13.08	1.306
O U	13	13.00	
S U	8	10.13	
C U	9	12.33	

On/offline and difference among schools were analyzed with pretest scores and since p-value is higher than the significance level of .01, subject to on, off or schools were not a controlling factor. And therefore, when comparing posttest scores, pretest scores were not necessary to take into account. So, when posttest scores were compared, instead of covariant analyses, t-test or one way ANNOVA was sufficient. Paired sample t-test for the pretest and posttest scores are displayed on **Table 7**. This table shows that the experiment had a positive influence for the groups ($p > .01$).

Table 7. Comparison between Posttest and Pretest Scores

	Mean	N	S	T score
Pre-test	12.33	42	3.667	-6.602***
Post-test	14.93	42	2.762	

Next, **Table 8** compared the pretest and posttest scores between the online and offline groups. First, two groups were compared according to gained pretest and posttest scores. Since both groups had a p-value higher than the significance level of .01, online and offline had a statistical difference for the pre and posttest scores. To see the kinds of differences, mean scores were examined and for the online group, pretest mean score was 12.73 while posttest was 15.14. For the offline group, there was also a higher gain of 11.90 to 14.70.

Table 8. Comparison of Pretest and Posttest Scores between Online and Offline Learning

		M	N	S	T score
ON-line	Pre-test	12.73	22	3.561	-4.589***
	Post-test	15.14	22	2.867	
Off-line	Pre-test	11.90	20	3.824	-4.660***
	Post-test	14.70	20	2.697	

Table 9 compared the pretest and posttest mean scores according to the schools and results show that all had a higher gain.

Table 9. T-Scores of the Four Schools

		M	N	S	T score
K U	Pre-test	13.08	12	4.316	-3.026**
	Post-test	15.25	12	3.166	
O U	Pre-test	13.00	13	3.916	-3.852**
	Post-test	15.23	13	3.193	
S U	Pre-test	10.13	8	2.100	-3.701**
	Post-test	13.88	8	1.642	
C U	Pre-test	12.33	9	3.162	-2.630**
	Post-test	15.00	9	2.500	

Low, mid, and high range scores were grouped according to the pretest scores and **Table 10** shows the comparison between gain scores. When scores are compared, pretest low and pretest mid-range group showed a higher gain after this experiment.

Table 10. T-Score for the Score Range

		M	N	S	T score
Pretest Low gained group	Pre-test	8.00	12	1.477	-8.025***
	Post-test	12.75	12	2.491	
Pretest Mid range group	Pre-test	12.50	20	1.732	-4.850***
	Post-test	14.95	20	2.259	
Pretest High range group	Pre-test	17.20	10	.919	-.758
	Post-test	17.50	10	1.650	

4.2 Multiple Regression Analysis

Multiple regression was performed to determine whether the variables involved in this research can predict the performances of the students after the experiment. Four variables were involved in this and next part of the analysis. First, score rate changes; rates of the difference between the posttest score and the pretest score were used as the dependent variable. Three independent variables were used to see if all or any of these variables might have contributed to the score rate changes. Three independent variables or the predictor variables are the schools, channels of lecture and the pretest score range. To simplify the names on the trees and tables, simplified codes were used for the variables and they are displayed on **Table 11**. ‘Changes’ in the charts and the figures denote the rate of the score changes between the pretest and the posttest. Next, the four schools are collectively called as ‘school’. Channels of the lecture are coded on the charts as ‘on off’ and finally, the pre-grade score ranges are written as pre_grade on the tables and the chart.

Table 11. Description of the Dependent and Independent Variables

Variables	Description	Code	Collective Code
Dependent variable	Rate of the score changes		changes
Independent Variables	Schools KU OU SU CU	 School 1 School 2 School 3 School 4	school
	Channels of the lecture	Offline Online	on off
	Pretest Score Range	Low Mid High	pre_grade

From the regression model, stepwise regression was used in this analysis. In stepwise regression, variables are entered into the model one at a time in an order of their correlation and variables that do not add to the success of the model are excluded with this method. First, **Table 12** shows that the three variables accounted for 38% of the variances (R^2 = .386). First, pre-grade was able to explain 23% of the rate changes, adding the channel of the lecture and then the school increased the rate by 38%.

Table 12. Stepwise Regression Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.483a	.233	.214	7.33062	
2	.564b	.318	.283	7.00333	
3	.622c	.386	.338	6.72808	2.340

[a]. Predictors: (Constant), pre_grade

[b]. Predictors: (Constant), pre_grade, on off

[c]. Predictors: (Constant), pre_grade, on off, school

[d]. Dependent Variable: changes

Table 13 shows the coefficients values of the predictor or the independent variables for the rate changes. Since standardized coefficients Beta value uses a standard unit as opposed to the unstandardized B, these values will be examined. Pre-grade was found to be the most significant predictor variable (Beta = -.483, p =.001). Negative beta value only explains the fact that the pre_grade and the rate changes had a negative relationship. Low grade students had a higher rate change while high grade students had none to low changes. And such findings coincide with the previous descriptive statistics. Pre-grade values are followed by the channels of the lecture (Beta = -.291, p = .034) and school (Beta = -.2.99, p = .046). Negative value for the channels of the lecture indicates that offline students who were assigned as 1 had a greater rate changes compared to the online students assigned to 2.

Collinearity values in this table indicate the correlation among the independent variables. And multicollinearity exists when there is a strong correlation among them (www.) Since the VIF values are all less than 10, multicollinearity do not exist among the independent variables in this research. This part of the analysis was able to find out that although not to a great extent, pre_grade, followed by the channel of the lecture were the determining factor to the rate

changes after the experiment. From these initial findings, cross validation was performed by creating decision tress to determine the extent these independent variables can contribute to the dependent variable. T

Table 13. Stepwise Regression Analysis Examining Score Rate Changes

Model		Unstandardized Coefficientsa		Standardized Coefficientsa	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	19.163	3.402		5.634	.000		
	pre_grade	-5.730	1.643	-.483	-3.487	.001	1.000	1.000
2	(Constant)	26.202	4.564		5.741	.000		
	pre_grade	-5.741	1.570	-.484	-3.657	.001	1.000	1.000
	on off	-4.753	2.164	-.291	-2.197	.034	1.000	1.000
3	(Constant)	35.626	6.332		5.627	.000		
	pre_grade	-6.227	1.526	-.525	-4.080	.000	.976	1.024
	on off	-7.004	2.348	-.428	-2.984	.005	.784	1.275
	school	-2.208	1.070	-.299	-2.063	.046	.770	1.299

[a]. Dependent Variable: changes

4.3 Cross Validation

Decision trees were used to cross validate the variables. Whereas the previous multiple regression analyzed the extent the independent variables had on the dependent variable, creating decision trees and the models can make predictions about the variables and determine the likelihood of the outcome. This **Fig. 22** is the graphic representation of the tree model with the score rate change as the dependent variable. The rate changes are grouped as low (decrease in score), none (no changes), and high (increase in score). Numbers after the group code indicates the rate changes by 5%: 1 for 5 %, 2 for 10% and so forth. Therefore, a student in high 1 had a 5% increase in his or her score after the experiment while a student in low 1 had a 5% decreased in his or her score.

Using the CHAID method, pre-grade was the best predictor of the rate changes. The pre-grade was categorized according to the pre-test score and the lowest 25%, who gained 0 to 9 points were categorized as the pre-grade group 1. For this low group, pre-grade level is the only significant predictor of the rate changes. Of the students in this category, nearly all the students improved their test scores after the experiment. Highest gainers are also in this category. Since there are no child nodes below it, this is considered a terminal node [18].

For the medium and high pre-grade categories, the next best predictor is the channel of the lecture. In other words, for those above the medium grade, online or offline education was a predictor for the changes. Whereas more than 40% of the students in this category didn't improve or scored less after the experiment, nearly 90% of the online students in this category improved their test scores. Since there are no child nodes below the offline category, the branching of the tree model is terminated.

Medium to high level students in the online category has another predictor, which is pre-test score. While high level students didn't gain or gained less or equal to 5% from this experiment, online students in the mid-range nearly all received more than 5% increase after the experiment.

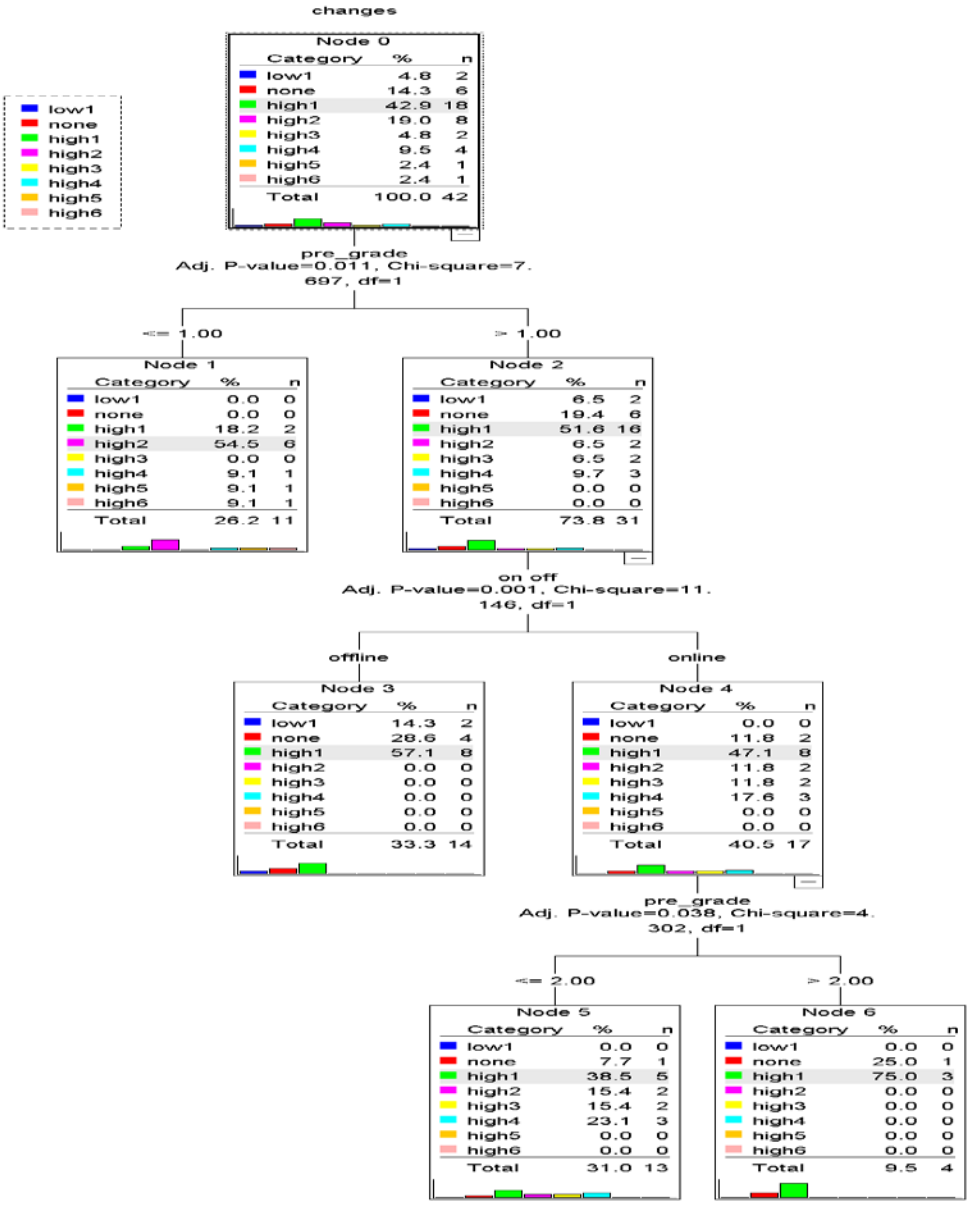

Fig. 22. Tree Diagram for Score Rate Change Model

The risk and classification tables on **Table 14** and **Table 15** provide a brief evaluation of how well the model works [18]. The risk estimate of .476 indicates that the category predicted by the model is wrong for 47.6 % of the cases. This means there is a risk of misclassifying a student is approximately 47%. The findings are consistent with the classification table. The table shows that the model classifies approximately 52.4 % of the students correctly. Therefore caution should be made in generalizing and concluding with only this set of data. For high 1 and high 2 students, correctly predicted ratings were more than 75%, which means that only 25% or less were inaccurately classified as ‘other’ groups. However, other categories, low,

none and high 3 to 6 were not predicted correctly. Small sample sizes and frequencies for these categories could have been the main cause of such risk and low correctness.

Table 14. Risk Estimate for the Model

Estimate	Std. Error
.476	.077

Growing Method: CHAID
Dependent Variable: changes

Table 15. Classification of the Model

Observed	Predicted								
	low1	none	high1	high2	high3	high4	high5	high6	Percent Correct
low1	0	0	2	0	0	0	0	0	.0%
none	0	0	6	0	0	0	0	0	.0%
high1	0	0	16	2	0	0	0	0	88.9%
high2	0	0	2	6	0	0	0	0	75.0%
high3	0	0	2	0	0	0	0	0	.0%
high4	0	0	3	1	0	0	0	0	.0%
high5	0	0	0	1	0	0	0	0	.0%
high6	0	0	0	1	0	0	0	0	.0%
Overall Percentage	.0%	.0%	73.8%	26.2%	.0%	.0%	.0%	.0%	52.4%

Growing Method: CHAID
Dependent Variable: changes

5. Conclusion and Implications

This research analyzed the data in three steps. First, descriptive statistics looked into the preliminary findings of the differences between the pretest and the posttest scores. Differences were compared among schools, channel of studies, and pre grade levels. Overall, the experiment had a positive influence on all the groups. Second, multiple regression was performed to examine the size of variance the three independent variables had on the score rate changes. Result showed that pre grade levels followed by the channels of the lecture had a determining factor on the rate changes. It is a generally known factor that lower grade students achieve more than the higher students and this experiment also agreed with the facts. Next the findings showed that on line students gained more than the online students. The final, cross validation analysis used decision trees to make predictions by layering and separating the independent variables.

Risk estimation and classification prediction showed some risk in predicting the outcome for other than the initial data, nonetheless the tree model displayed some interesting findings. The experiment particularly worked well for the online students in the mid-range group. Previous experience in online lectures and the familiarity with the online devices have worked positively for this experiment. Therefore, to improve the learning experiment, considerable amount of time should be spent to familiarize the smart phone devices to the learners.

With the actual statistics data, a brief survey also showed that self-directed learning via smartphone was quite encouraging. Nonetheless, the survey suggests that there are needs for feedback functions between instructors and learners. To encourage students' participation,

communication and feedback functions, such as twitter, blog or RSS should be added and to increase predicted rating for the decision trees, greater number of students should participate for future research.

In a nutshell the most useful advantage of proposed English m-Learning contents seems to be the mobility of learning contents however experiment results showed that this proposed learning can actually encourage self-directed learning process for the learners.

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