Design of an Online Multimedia Learning System for Improving Students' Perceptions of English Language Learning

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***Abstract*—Over the last few decades, there has been a growing interest in technology assisted multimedia learning. The purpose of this study was to develop an online multimedia learning system, TEDQuiz, for English language learners to practice their listening skills. The system is comprised of an easy-to-use browser extension and a personalized online learning management platform. This can help learners to manage listening materials by automatically generating multiple–choice questions, synchronously connecting to friends in a social network website and personally managing their learning progress and word bank. The use of the system involves six steps: skimming, asking questions, listening, answering questions, linking and reviewing. Taking TED talks as an example, users can skim the website, have guiding questions, listen to talks, answer the questions, link to a social network website, and review their profile on the TEDQuiz website. The experimental results demonstrate that students with the TEDQuiz system spent more time on video watching. In the questionnaire, students had a positive view of the functions of the TEDQuiz system. They thought it is useful and helpful, and they were willing to use it in the future. We also found that the usefulness factor was statistically significant in predicting the future usage of TEDQuiz.**

Keywords-multimedia learning, computer assisted language learning, listening comprehension, learning management system, toolbar, question generation

I. INTRODUCTION

Research on the multimedia learning in Computer Assisted Language Learning has been mounting steadily for a number of decades [1-3]. It has been found that compared to verbal learning, people can learn better from words, pictures, animation and video because the presentation of materials is consistent with the nature of the human cognitive system [3]. With the development of computers and the Internet, many online resources have become available and are updated every day. The growth of online learning resources can change the way people acquire knowledge, with learning being possible through online courses or other online materials, such as videos on YouTube[1] or TED talks[2]. These resources are particularly useful for foreign language learners with little exposure to the foreign language in their environment because they can acquire the target language by simulating the situation, in online videos for example, for language practice.

How to foster listening comprehension has been an important issue in the development of multimedia learning [4]. Captions and subtitle in multimedia instruction help learners obtain a better understanding of the target language content when they have some unknown words in the auditory track. Similarly, transcripts incorporated into multimedia can help leaners to recognize the main idea in the entire text and overcome listening difficulties in the target language. In addition, annotations displayed as pictorial explanation and textual clarification can assist them to acquire unknown words and facilitate listening comprehension. Even though a fairly large body of literature exists on technology assisted multimedia learning [5][6], these studies primarily have focused on managing and reducing the cognitive processing, and little research has explored the design and the assessment of multimedia learning.

To assist listening comprehension in English as a Foreign Language, we developed an online multimedia learning system, called TEDQuiz, that includes a browser extension and web-based management system. It assists learners to manage online video resources and offers several functions like question generation, social networking, a personalized word bank, and online dictionary. An effective listening strategy in the use of the system should include the following six steps: skimming, asking questions, listening, answering questions, linking and reviewing. Users can first look for learning materials they are interested in, which will enhance their multimedia learning experience. Here, we adopted TED talks as an example of a research material in multimedia learning. TED is an acronym for Technology, Entertainment, and Design. Experts in different fields are invited to give a short talk to spread their ideas. The quality of TED talks makes it a useful resource for English language learners to acquire new knowledge and to improve their language skills at the same time. Moreover, the length of a talk, which is in general less than eighteen minutes, is short enough to sustain leaners' attention. The research questions addressed in this study are: (1) With TEDQuiz, will users spend more time

[1] http://www.youtube.com/
[2] http://www.ted.com/

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learning by watching TED talks? (2) How do learners perceive TEDQuiz as an online multimedia learning tool?

II. METHOD

How does the TEDQuiz system operate? What is the study strategy when learning with the system? In this section, we will answer these questions.

A. System Overview

The architecture of TEDQuiz is a client-server-based system, as shown as Figure 1. The client side includes a TEDQuiz toolbar and a TEDQuiz website. The toolbar is a browser extension, a Mozilla Add-on that is embedded in the browser Mozilla Firefox, and it is implemented by Firefox Extensions, jQuery Library, and JQuery UI Library. A browser extension, i.e., an add-on or plug-in, is a kind of small software which can access and extend the functionality of a web browser. Taking the addition of a toolbar on the web browser as an example, the browser extension can modify the user interface of the web browser rather than directly affect the content of a web page. And the extension can allow for the retrieval of data from the content of webpages and operate in the background without interfering with the view of the current web page. A screenshot of the TEDQuiz toolbar is depicted in Figure 2. The TEDQuiz website is an online learning management platform that is based on PHP programming language and designed for users to review their record and profile, so that they can easily manage their learning activities.

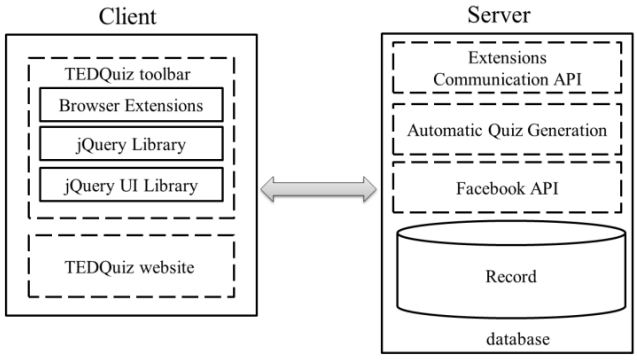

Figure 1. The system architecture of TEDQuiz system.

The server side consists of Extensions Communication API, Automatic Quiz Generation, Facebook API and MySQL database. The Extensions Communication API is designed to interact with the Browser Extensions of the client side. The automatic question generation, one of important components from the TEDQuiz system, can automatically produce listening comprehension questions. When users make a decision on which talk will be watched, the transcript of the talk will be crawled and passed to the question generation, which will then generate comprehension questions to be given to the users. Moreover, the TEDQuiz system shares users' activity on a social network website with the Facebook API in order to enhance learner interactivity and motivation. Finally, the database stores user behavior and records it on the TEDQuiz system.

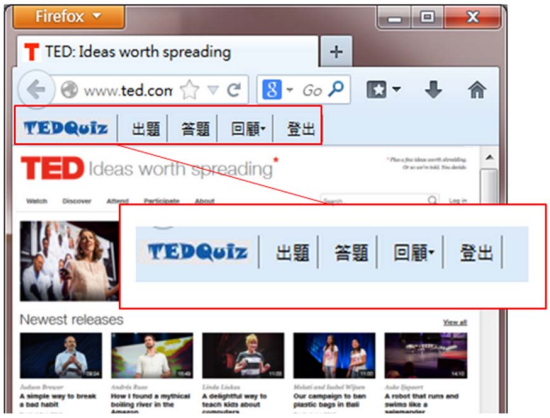

Figure 2. A screenshot of the TEDQuiz Toolbar (preview /出題, answer/答題, review/回顧, logout/登出).

B. Learning Process

The design of using the system involves the six steps of skimming, asking questions, listening, answering questions, linking and reviewing. This basic idea was inspired by the effective study strategy SQ3R developed by Robinson [7] to improve learning using the five steps of surveying, asking questions, reading, reciting, and finally reviewing.

The first step, skimming (or surveying), involves users freely browsing through the TED talks website. Over 2100 talks had been made available on the website by February 2016. The talks cover a wide range of topics within the research and practice of science and culture, and are often presented in a storytelling way. Before listening, users can skim the title, the speaker and the introductory summary of talks.

In the asking questions step, the system automatically formulates questions related to the content when a user choses a talk. For each talk, the system generates one gist-content question and four detail questions based on Natural Language Processing techniques. The gist-content questions test the main idea of listening passages. We used a graph-based algorithm, LexRank [8], to identify the most important part of a talk about which a gist-content question is generated. As for the four detail questions, they are related to the details or facts from the passages. The detail questions include ***what***, ***when***, ***who***, ***whose***, *and* ***how many***. We extend Heilman and Smith's work [9][10], which used general-purpose rules to transform declarative sentences into questions. The intuition is that when users fully comprehend a given talk, they could identify the main idea of the given content and distinguish the correct answer from the incorrect choices (for more details, see [11]). In this step, the system only shows questions without choices in order to help users to identify and develop their knowledge. Thus, when users click the preview button on the toolbar, the TEDQuiz system will operate in the background and show the questions without interfering with the TED talks website.

Rather than passive listening, "listen" in this step means that users listen and watch the video in order to answer the

questions raised by the previous "asking questions" step. Moreover, users can watch the video repeatedly until they feel they fully understand the content.

The next step is to answer the questions (with choices). We select words with the same POS tag and SuperSense tag from the content of the talk and rank them in either Google N-gram corpus or BNC corpus (if there are less than three choice candidates) in order to generate grammatically correct but semantically wrong sentences as alternatives (for more details, see [11]). As Figure 3 shows, users need to recognize the major points and distinguish an answer from plausible alternatives based on the understanding of the video content. In this way, users can not only receive the message from the video but also reflect on the implications of the information in order to answer the questions.

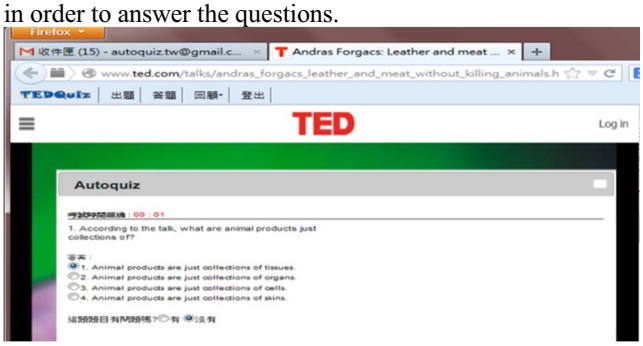

Figure 3. An example of the question answering.

Linking is the step that makes connections with friends in the social network website, Facebook. Users can share talks, scores, questions and their comments in the social network after the answering stage. When they have any opinion about the video, they can post the talk and their comments on their wall of the social network in order to build their own learning community. Their friends can then watch it and discuss it if it interests them. In the example illustrated in Figure 4, a user did not answer a question correctly and asked for help. This step thus makes a connection between the user and others; users can thus not only watch the video alone but also interact with friends who watch it as well. Likewise, if a user's friends post a TEDQuiz message, other users may be interested in it and click the post to watch it. This is a pull strategy to keep users in the multimedia learning environment.

Figure 4. An example to show a user asking for help when he answered a question incorrectly.

The final review step is an ongoing process which encourages users to practice repeatedly until they fully understand the content of the video. A personalizing function helps users review which videos they have already watched, how they did in the answering step, and which words they had not acquired yet. After users listen to (or watch) a video and answer questions, the TEDQuiz system stores the record and organizes the questions they have answered. If there were questions they could not answer correctly, they might not have recognized the meaning or the pronunciations of some words in the correct answers. The system automatically lists the function words from the questions, and in order to help users to learn the unknown words they could not recognize, the system connects to an online bilingual dictionary, shown in Figure 5. Users can manage their learning profile and practice again in the future.

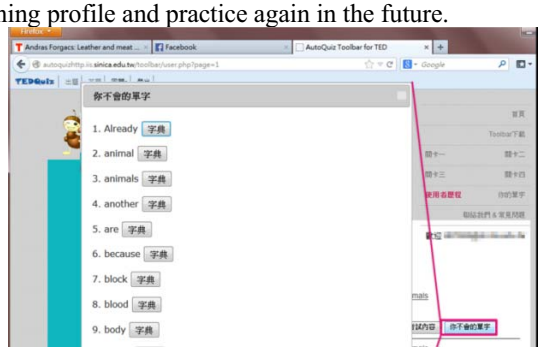

Figure 5. An example of listing words in the question which the user answered incorrectly.

III. EXPERIMENT

Will students spend more time learning by watching TED talks? How do students perceive TEDQuiz as an online learning tool? In the experiment, we firstly observed the user activity log to examine whether users engage in the TED talks website more than they did before using TEDQuiz. Next, we adopted a questionnaire to investigate the effectiveness and the functions of TEDQuiz.

A. Experimental Setting

The participants in this experiment were 76 senior high school students in Taiwan taking English as a foreign language (EFL). During the experiment, the subjects were asked to watch as many TED talks as possible under two conditions. The first condition was only to watch TED talks, while the second was to watch TED talks with TEDQuiz. At first, the subjects were introduced the TED talks website and asked to install the TEDQuiz toolbar into their browser. The toolbar recorded their activity logs on the TED talks website. The period of each task was a week. In each week, the subjects were asked to watch at least four TED talks in order to ensure the engagement of their participation. Users could control the speed on their own with forwarding, rewinding, or stopping the videos. Finally, 49 subjects answered a five–point Likert scale questionnaire to express their experience on the system. The questionnaire was edited from [12] and was seen as an instrument of usability test.

B. Engagement

To validate the effectiveness of the proposed TEDQuiz system, the retention time from two tasks were compared.

The term "retention time" refers to the period in which subjects watch a video on the TED talks website. We only considered the lengths of the periods that were longer than one minute. Table I reports mean and standard deviations in the two tasks. The results suggested that subjects with TEDQuiz on the average (M= 44.54, SD=44.52) watched more TED talks than they used to do (M=12.11, SD=29.89). The higher variance may be due to the individual variation of some subjects greatly increasing the duration from the first task to the second task. Subjects spent more than 32 minutes on the TED website after using TEDQuiz. The length of retention time was 3.68 times longer than the previous task. Moreover, the paired sample T–test, $t(75)=-5.04$, $p<0.001$, showed a significant effect between two tasks. These findings indicate that users with TEDQuiz were willing to spend more time on the multimedia than they used to do under the first condition.

TABLE I. THE MEAN AND STANDARD DEVIATION IN THE TWO TASKS

Condition	Mean (min)	S.D.
TED talks	12.11	29.89
TED talks+TEDQuiz	44.54	44.52

C. *Questionnaire Results*

In terms of evaluating the features of the TEDQuiz system, nineteen questions in the questionnaire concerning the subjects' perception were investigated. Table II displays the questions, and shows the distribution of scores and their mean score and standard deviation. Overall, the findings reflect a highly positive opinion towards the system (overall mean=3.55, SD=1.05). Several items in Table II are worth mentioning. The students strongly agreed with the question (item 1, 2) and the review (item 15) functions generated from the TEDQuiz. Moreover, they thought the TEDQuiz system was interesting (item 8) and useful for listening proficiency in English (item 16), and it helped them learn English with multimedia (item 17). Surprisingly, the subjects seemed uncomfortable and reluctant if the system posted messages on the social network website (item 3, 14), but the messages still attracted their attention (item 4).

In order to further investigate the questionnaire, an exploratory factor analysis with varimax rotation was used, even though we derived the questionnaire from a previously published study [12]. The nineteen questions were categorized into four factors: functionality - examining the functions provided by TEDQuiz (item 1-5), perceived helpfulness - representing how the system helps learners learn with multimedia (item 6-9), usefulness - referring to the degree of ease to use and how useful the system is (item 10-16), and willingness for future usage - relating to whether users are willing to use this system in the future (item 17-19). The percentage of variance explained for each factor was: 46.02% for functionality, 13.76% for perceived helpfulness, 8.55% for usefulness, and 7.29% for willingness for future usage. A total of 75.61% variance could be explained. In addition, each factor showed high internal consistency (Cronbach's α= 0.84, 0.73, 0.82, and 0.90, respectively). Most subjects agreed the functions of TEDQuiz system (average mean of functionality = 3.44, SD = 0.79) and they thought it was helpful (average mean of perceived helpfulness = 3.55, SD = 0.84) and useful (average mean of usefulness = 3.52, SD = 0.74) because it could help them learn and practice listening skills. In the future, they would like to keep using it when they watch video (average mean of willingness for future usage = 3.78, SD = 0.911).

To evaluate whether learners would use TEDQuiz in the future, a linear regression was performed. The ANOVA indicates a significant main effect of the model ($F=16.53$, $p<0.001$). The coefficients for willingness for future usage among functionality ($b=0.08$, $p=0.63$), perceived helpfulness ($b=0.34$, $p=0.12$) and usefulness ($b=0.48$, $p=0.05$) are positive. This model could explain 52% of the variance, implying that students felt that the usefulness of the system had a significant effect on their willingness to use it in the future.

IV. DISCUSSION AND CONCLUSION

In this work, we introduced TEDQuiz - a learning system for TED video clips. We evaluated its effectiveness from a usability perspective. The system assists learners to manage listening materials by automatically generating multiple–choice questions, synchronously connecting with friends in the social network website and personally managing their learning progress and word bank. The use of the system involves the six steps of skimming, asking questions, listening, answering questions, linking and reviewing. The experimental results demonstrate that the students spent more time on the TED website when they watched the TED videos with TEDQuiz. We conducted a survey on the functionality, perceived helpfulness, usefulness, and willingness for future usage of TEDQuiz. The responses from the questionnaire were positive, with a significant effect on usefulness. Another finding in the survey was that although students claimed that the TEDQuiz posts on the social network website caught their attention, they tended to be conservative when posting their own learning profile.

TEDQuiz creates a new way of online interaction among learners, materials, and friends. In the traditional online multimedia learning environment, users only watch the talks on the screen, receive information in a one way direction, and process visual and auditory information from video streaming. In contrast, with TEDQuiz, users can not only receive the information from the video but also reflect on the implications of the listening passage in the stage of answering comprehension questions. Moreover, users can share the talks that they watched on the social network website and discuss them with friends in the linking step. Likewise, they can also be encouraged by their friends to watch a talk and learn from it.

Several implications can be drawn from this study if learners practice listening proficiency with this system. TEDQuiz has several potential benefits to foster online multimedia learning. First, it is easy to install and only requires one-click to add the application feature, rather than involving a complicated installation. Second, it takes away the barrier of the physical academic textbooks. Also, as the online TED resources are updated every day, learners can be

TABLE I. QUESTIONNAIRE RESULTS

	Item	1(%)	2(%)	3(%)	4(%)	5(%)	M	SD
1	When I read the questions generated by TEDQuiz, I tried to answer them.	2	4.1	6.1	42.9	44.9	**4.24**	0.90
2	When I read the questions generated by TEDQuiz, I paid attention to the questions.	4.1	6.1	20.4	30.6	38.8	**3.94**	1.11
3	When I read the facebook post from one of my friends, I tried to join the discussion.	6.1	18.4	59.2	10.2	6.1	2.92	0.89
4	Because TEDQuiz posts the message, I paid attention to the TED talks.	10.2	20.4	40.8	14.3	14.3	3.02	1.16
5	I want to use the functions of the TEDQuiz system.	8.2	14.3	49	20.4	8.2	3.06	1.01
6	The integration of TEDQuiz and the TED website helped me understand the content of the video.	4.1	12.2	40.8	30.6	12.2	3.35	0.99
7	The integration of TEDQuiz and the TED website helped me learn English.	4.1	8.2	34.7	32.7	20.4	3.57	1.04
8	The experience of using TEDQuiz was interesting.	4.1	6.1	24.5	32.7	32.7	**3.84**	1.09
9	The TEDQuiz toolbar did not interfere with the usage of the TED Talks website.	10.2	14.3	26.5	18.4	30.6	3.45	1.34
10	Installing the TEDQuiz toolbar did not frustrate me.	14.3	12.2	28.6	24.5	20.4	3.24	1.32
11	After some practice, it was easy for me to use each function of TEDQuiz toolbar.	10.2	10.2	30.6	28.6	20.4	3.39	1.22
12	The TEDQuiz toolbar described all the functions clearly.	2	18.4	30.6	26.5	22.4	3.49	1.10
13	The questions generated by TEDQuiz system were useful for me.	0	6.1	36.7	32.7	24.5	3.76	0.90
14	Sharing TEDQuiz messages with friends was useful for me.	10.2	12.2	46.9	18.4	12.2	3.10	1.10
15	Reviewing and managing my profile on the TEDQuiz platform was useful for me.	0	6.1	40.8	34.78	18.4	3.65	0.86
16	TEDQuiz is useful for listening proficiency in English.	0	10.2	12.2	42.9	34.7	**4.02**	0.95
17	TEDQuiz motivates me to learn English with multimedia.	2	8.2	14.3	42.9	32.7	**3.96**	1.00
18	I would like to keep using TEDQuiz in the future.	2	6.1	30.6	36.7	24.5	3.76	0.97
19	I would like to use TEDQuiz as a tool of practicing listening proficiency in English.	4.1	8.2	30.6	36.7	20.4	3.61	1.04

able to practice and learn something new whenever they want. Furthermore, since TEDQuiz allows learners post message on a social network website, they can collaborate with peers and cooperate on the listening comprehension. Finally, TEDQuiz provides a personalized learning material management, helping learners to benefit from learning new words and overcoming comprehension breakdowns.

In this study, TEDQuiz system was only evaluated in the user perceptions and generated five questions (one gist-content question and four detail questions). Sometimes, TEDQuiz generated a grammatically unclear or incoherent question. In the future, we will improve the quality of generate questions and develop various comprehensive questions; moreover, we will assess whether TEDQuiz can improve students' listening skills.

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REFERENCES

[1] P. Brett. "Multimedia for listening comprehension: The design of a multimedia-based resource for developing listening skills," System, vol. 3, Feb. 1995, pp. 77-85, doi:10.1016/0346-251X(94)00054-A.

[2] E. M. Golonka, A. R. Bowles, V. M. Frank, D. L. Richardson and S. Freynik. "Technologies for foreign language learning: a review of technology types and their effectiveness," Computer assisted language learning, vol. 27, Sep. 2012, pp. 70-105, doi: 10.1080/09588221.2012.700315.

[3] R. E. Mayer, Multimedia Learning, Cambridge University Press, 2009.

[4] M. A. Mohsen. "The use of help options in multimedia listening environments toaid language learning: A review," British Journal of Educational Technology, May 2015, doi: 10.1111/bjet.12305.

[5] A. N. Leveridge and J. C. Yang. "Testing learner reliance on caption supports in second language listening comprehension multimedia environments," ReCALL, vol. 25, May 2013, pp. 199-214, doi: http://dx.doi.org/10.1017/S0958344013000074.

[6] C. C. Chang, K. H. Tseng, and J. S. Tseng. "Is single or dual channel with different English proficiencies better for English listening comprehension, cognitive load and attitude in ubiquitous learning environment?" Computers & Education, vol. 57, Dec. 2011, pp. 2313–2321, doi:10.1016/j.compedu.2011.06.006.

[7] F. P. Robinson. Effective study. NY: Harper & Row, 1970.

[8] G. Erkan and D. R. Radev, "LexRank: graph-based lexical centrality as salience in text summarization," Journal of Artificial Intelligence Research, vol. 22, 2004, pp. 457-479, doi: 10.1613/jair.1523.

[9] M. Heilman and N. A. Smith, "Question generation via overgenerating transformations and ranking," Technical report, Language Technologies Institute, Carnegie Mellon University Technical Report CMU–LTI–09–013, 2009.

[10] M. Heilman and N. A. Smith, "Good question! statistical ranking for question generation," Proc. North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Association for Computational Linguistics, June 2010, pp. 609–617.

[11] Y. T. Huang, Y. M. Tseng, Y. S. Sun, and M. C. Chen, "TEDQuiz: automatic quiz generation for TED talks video clips to assess listening comprehension," Proc. Advanced Learning Technologies, IEEE, July, 2014, pp. 350-354.

[12] Y. C. Chen, R. H. Hwang, and C. Y. Wang. "Development and evaluation of a Web2.0 annotation system as a learning tool in an e-learningenvironment," Computers & Education, vol.58, May 2012 pp. 1094–1105, doi: 10.1016/j.compedu.2011.12.017.