Journal of English Language
Teaching and Learning
No. 15, 2015

Multimedia Annotation: Comparability of Gloss Modalities and their Implications for Reading Comprehension

Hamed Babaie Shalmani (Corresponding author)
Member of English Language Department, College of Humanities, Rasht Branch, Islamic Azad University, Rasht, Iran
Seyyed Ayatollah Razmjoo
Associate Professor, Shiraz University

Abstract

This study compared the effects of two annotation modalities on the reading comprehension of Iranian intermediate level EFL learners. The two experimental groups under study received treatment on 10 academic L2 reading passages under one of two conditions: One group received treatment on key words in the reading passages through a multimedia environment providing textual annotations. The second group received treatment under a similar environment but received compound glosses. The control group, however, received no treatment and was encouraged to use contextual guessing. The findings revealed that the experimental group who received treatment through compound glosses outperformed the other two groups on the comprehension test, and the group who used textual annotations obtained a higher mean on the post-test than the control group. One explanation is that compound glosses might help learners better decipher the meanings of key words in L2 passages, thus contributing to their deeper understanding of the texts.

Keywords: Compound gloss; Dual Coding Theory; Reading comprehension; Technology-Enhanced Language Learning; vocabulary annotation.

تاریخ وصول: ۹۳/۸/۲۸ تأیید نهایی: ۹۴/۱/۱۷

E-mail: babaie@iaurasht.ac.ir
E-mail: arazmjoo@rose.shirazu.ac.ir

Background

Convictions are strong that reading proficiency is a major determinant of academic success at all ages, from the primary school right through to university level. As a rule of thumb, students who read a lot and who understand what they read usually attain good grades. In postgraduate programs, harnessing reading skills is never the less of greater consequence where students are required to go through hundreds of academic texts in no time. The exigencies, then, have pushed a great many ELT researchers and practitioners to propose a plethora of strategies to be utilized by learners while reading in academic settings. Two known ones are *gisting* and *contextual guessing* reading strategies (Birjandi, Mosallanejad, & Bagheridoust, 2006; Lee & Oxford, 2008; Pigada & Schmitt, 2006; Plakans, 2009; Zaid, 2009).The gisting strategy, also known as skimming, involves quickly going through a whole text or a fragment of a passage for its gist. With the help of this strategy, one is able to predict the message or purpose of the writer, as well as to develop or support ideas. With a clear picture of the passage the students have in their mind, they can then take on more focused reading (Brown, 2001).

As still another widely employed strategy, contextual guessing involves processing neighboring contexts for clues to discovering and demystifying the meanings of unknown words in reading texts. Indeed, one can make semantic predictions about the ties and relationships among the words so that he can efficiently decode the meanings and hence arrive at clear understanding of the text. In favor of this argument, Underhill and Batt (1996) posit that lexical decision latency, which is responsible for word recognition and understanding, is significantly reduced if the words are preceded or followed by semantically related terms in the neighboring contexts of usage. Bengeleil and Paribakht (2004) likewise assert that in the initial comprehension of unknown vocabulary in L2 passages, the primary lexical processing strategy available to the learners is guessing through linguistic cues.

Albeit these strategies have been frequently suggested by teachers and utilized by learners in L2 reading, a great many learners, EFL learners in particular, fail to develop the required reading skills ensuring their academic success. Chief among the culprits is that, at times, learners have to go through discipline-specific texts replete with technical vocabulary. Accordingly, gisting may not necessary prove fruitful in helping students arrive at sound understanding of the passages, as those words are key to the understanding of the texts. In a similar vein, incorrect guesses may lead to comprehension breakdown, or even misunderstanding on the part of L2 learners. To obviate this problem, *glossing* or *annotation* of vocabulary items has been proposed in research literature as an effective solution that may hold great promise for harnessing reading skills among L2 learners. A growing body of research (Akbulut, 2008; Al-Seghayer, 2001; Bowles, 2004; Chun & Plass,1997; Davis, 1989;Gettys, Imhof, & Kautz, 2001; Hong, 2010; Jones & Plass, 2002; Ko, 2005;Lomicka, 1998; Martinez-Lage, 1997; Roby, 1999; Rott & Williams, 2003; Yoshii, 2006) has reached a unanimous consensus that, glosses, the explanations, definitions, or even synonyms of vocabulary items written on the margins of L2 passages, can aid both the acquisition of vocabulary and comprehension of reading texts through expediting lower-order word recognition and hence helping learners allocate a greater portion of their working memory capacity to the processing of higher-order comprehension skills.

In general, research on glossing has privileged vocabulary annotation for the following reasons: First, by avoiding incorrect guessing, annotations can help readers understand new words more accurately. As Stein (1993) and Nation (2001) aptly argue, guessing from context can be risky, especially for low-proficient students who lack the necessary skills and adequate knowledge of words to bring to reading L2 texts. Second, glosses may raise levels of concentration, since they do not interrupt the reading process as the definition of terms is readily available on the margins. Third, there is great likelihood that, through glossing, readers can more efficiently build a bridge between previous knowledge of the text and the new pieces of information as reading progresses (Stewart & Cross, 1993). Finally, glossing may foster learners' autonomy, as students feel more responsible for their reading through their higher engagement with the texts. This can make learners become less dependent on their teachers in approaching L2 passages over time (Gardner, 2011).

With the tools of technology finding their way to language classrooms, it is now possible to exploit the potential of multimedia glossing that allows for greater comparability of different gloss types. Indeed, thanks to their capacity to combine multiple forms of media such as sound, still pictures, animation, and son on, multimedia settings are believed to provide a rich environment for comparing the relative effects of glosses (Chun & Plass, 1997;Lomicka, 1998).In line with arguments for the use of computerized glosses, Davis (1989) states that hypermedia or multimedia could be used to expand the amount of information available to the reader and to individualize the learning experience by hiding the glossing until the reader feels the need to access it. He likewise contends that annotations are invisible and unobtrusive, which decrease the amount of extra information and increases the flow of reading due to the availability of immediate access to the required extra information for the reader.

A growing body of evidence, then, corroborates the contributions of glossing to reading comprehension, in general, and vocabulary learning, in particular. Yet little research (Al-Seghayer, 2001; Bowles, 2004; Cheng, 2009; Iheanacho, 1997; Yanguas, 2009; Yoshii, 2006) has probed the question of whether the use of different types of glosses may contribute differently to vocabulary acquisition and reading comprehension. Glosses can take different modalities such as textual, pictorial, audio, and so on, and the varying effectiveness of individual gloss types or different combinations of modalities may produce varying degrees of learning outcome. Moreover, prior research on glossing suffers from major drawbacks: First, none of these studies drew on a control treatment, a placebo, as a criterion for determining the comparability of traditional methods and glossing. Indeed, they all took for granted that glosses, whether traditional paper-and-pencil or computerized, would necessarily prove more fruitful than any extant method, even contextual guessing. Second, some studies like those of Al-Seghayer (2001) and Bowles (2004) employed a small sample, not representative of a larger population. Accordingly, the findings could not necessarily be generalizable to other contexts. Third, the use of intact classes in studies like that of Cheng (2009) might have confounded the effects of experimental treatments, largely owing to the participants not being random assigned to equivalent groups in terms of vocabulary command, reading comprehension skills, level of motivation, and so on. One may argue the participants with unique characteristics were not equally distributed across the groups under study, resulting in sample bias. Forth, the overriding focus of all these studies was on vocabulary acquisition, even those whose main objective was to explore the relative effects of glossing on reading comprehension. In Cheng's (2009) study, for instance, only five reading comprehension questions, and in Yanguas' (2009) experiment, only 11 were used to measure the participants' understanding of the texts through glossing. Finally, almost all these studies measured the effectiveness of glossing in reading texts comprising concrete, non-technical vocabulary. Nevertheless, academic reading textbooks practiced at universities contain discipline-specific vocabulary too, and no research has yet explored whether glossing may also aid the decipherment of abstract, technical terms, and hence effective comprehension of texts. The type of passages used in prior research, then, lacked authenticity in the sense that the key terms were carefully selected for their concreteness and controlled for their technicality, and hence the texts could not represent the types of passages the students would encounter in academic settings. Since the major aim of research in any discipline is to improve the status quo, it might be intriguing if relative effects of different gloss modalities are compared so that the best modality for improving reading skills could be determined. Of particular interest is the investigation of the degree to which glossing may prove fruitful in clarifying the meanings of abstract, technical vocabulary and the improvement of reading comprehension accordingly.

Objectives of the Study

Due to a paucity of research on the contribution of glossing to L2 reading, and given that prior research on glossing focused on concrete, non-technical key vocabulary in reading texts, the present study sought to compare the effects of two gloss modalities, that is textual and compound (pictorial + textual) glosses, in academic L2 texts with those of a conventional method, that is contextual guessing, on the improvement of L2 reading comprehension skills among Iranian intermediate level EFL learners. The study aimed to ascertain whether glossing in multimedia environments would prove more fruitful in aiding comprehension skills than the traditional method. Provided that glossing appeared more effective, the study would then explore the relative effects of the two gloss modalities on reading comprehension skills in discipline-specific texts comprising abstract, technical vocabulary.

Research Questions

This research sought to address the following questions:

1. Is there any statistically significant difference in the use of multimedia glosses and contextual guessing in aiding L2 reading comprehension skills?
2. Is there any statistically significant difference in the use of textual glosses and compound glosses in aiding L2 reading comprehension skills?

Significance of the Study

Regrettably, prior studies on glossing, fraught with the aforementioned shortcomings, could not provide ELT practitioners with the rationale for the likely superiority of multimedia gloss over the traditional methods. They all took for granted the potential benefits of glosses without recourse to any control treatment that would represent a criterion against which the efficacy of glossing could be appraised. Moreover, those studies exploring the effects of glossing on reading comprehension skills fell short of accounting for the efficacy of glossing, as the length of the comprehension texts was not adequate enough and the number of follow-up comprehension questions was so limited to yield an accurate estimate of the degree to which glossing might have efficiently harnessed the participants' higher-order reading comprehension skills. Concerning these pitfalls, the present study, then, aimed to offer the following advantages over prior research:

1. This research employed a larger sample size to ensure generalizability of findings across diverse research contexts.

2. This research also used authentic academic passages whose vocabularies were not controlled for concreteness and technicality.
3. The study utilized lengthier texts, with more follow-up comprehension questions to provide a comparatively more valid estimate of reading comprehension skills harnessed through glossing.
4. The present study drew on a control treatment so that the comparability of glossing and contextual guessing could be determined. Contextual guessing, as a traditional strategy of approaching reading texts, has been around for a while and is widely encouraged by teachers, and hence may prove as much beneficial as any other method.
5. The present research used more versatile pieces of courseware featuring the cutting-edge multimedia technology that would allow for greater comparability of different types of glosses. The pieces of software used in prior research were hypertext programs in which different fragments of texts were linked together. Yet the programming language used for the development of these pieces could not allow for the incorporation of gloss types other than textual glosses. It was, therefore, hoped that the multimedia programs utilized in this study would provide a richer environment in which the relative effects of different types of glosses could be readily compared.

Method

Participants

The participants involved students who were majoring in Teaching English as a Foreign Language (TEFL), Literature, and Translation at two Iranian universities. To encourage the participants to take part in the study, necessary arrangements were made with the research deputies at the researchers' universities to reward the participants with money. For the requirements of the present study, it was necessary to select intermediate level students for the following reasons: First, for students at this level, a fair amount of L2 proficiency has already been established in terms of vocabulary command and the ability to read fairly complex, usually non-technical texts. Accordingly, chances were high that these students could reap much benefit from contextual guessing, which would require the processing of neighboring words to arrive at the meanings of unknown terms. Since the present study involved the comparison of students' performance on L2 texts comprehension achieved through guessing or aided by glossing, the efficient use of guessing technique was essential so that the comparability of the two methods could be accurately estimated. Second, as opposed to advanced-level learners, who could bring a wealth of vocabulary and background knowledge to processing reading texts, intermediate level students were less likely to have developed a good command of low-frequency, technical terms and hence were believed to serve as the most suitable candidates for the objectives of this study.

The prospective participants were also required to sit for a language proficiency test based on the UCLESIELTS examination papers. From among them, 160 individuals were ultimately chosen as the participants based on the scores they got on the test of proficiency. Since the initial participation was voluntary and the participants would be rewarded, a great many students took part and more than 160 individuals were qualified as intermediate level students. A simple random sampling was then utilized to randomly select the required number of participants from the qualified population. These were then randomly assigned to four equivalent groups of individuals: one pilot group, two experimental groups, and one control group. It should be noted, however, that the groups of participants comprised a mix of male and female students.

Instruments

The main instruments comprised two pieces of multimedia courseware authored by one of the researchers (see the appendix for software development).The multimedia programs consisted of 10 academic reading passages on discipline-specific themes such as Supernovae, Insects' Anatomy, Deep Vein Thrombosis (DVT), and so on. One of these programs provided the participants with textual annotations. That is, upon moving the mouse cursor over the words, a textual definition of them would pop up on the screen. The other program used compound glosses where both textual and pictorial definitions of words would pop up upon moving the mouse cursor. The passages were also coupled with 10 comprehension questions in the multiple-choice format would appear in a separate template above the texts. Both programs also came with a dedicated, built-in countdown timer to simulate a real testing situation and control the time variable across the two experimental groups. Drawing on Action Script programming and using *shared objects*, which act like *cookies* in HTML programming, the researcher developed the programs in such a way that they would automatically save the students' profiles in a log file for later analyses. The profiles contained students' information, the frequency counts representing the number of times or frequency with which the participants used or did not use the very type of gloss, as well as their right and wrong answers.

Other instruments involved an IELTS proficiency test that was used to choose the participants of the desired proficiency level; a multimedia reading comprehension pre-test in the multiple-choice format that was used to allow the participants to use contextual guessing before receiving treatment through glossing, and a multimedia reading comprehension post-test that was used to measure the participants' understanding of the texts after the treatment session.

Procedures

At the outset of the study, the proficiency test was administered to the prospective participants who were majoring in TEFL, Literature, and Translation at two Iranian universities. Based on the scores they obtained on the test (4.5 or 5), and in line with the rating scale proposed by the UCLES, all participants who got the required overall band score were identified as intermediate level EFL students. Since a total of 187 students taking the test were identified as intermediate level learners and this outnumbered the participants required for the study, a digital randomizer called Super Cool Random Number Generator[1] was utilized for randomization purposes. The program featured the capability to select a random set of numbers from within a specified range. Accordingly, all the participants who were identified as the qualified candidates were first assigned a number based on the total number of the participants who got the required overall band scores. That is, each of 187 prospective participants was assigned a number from 1 to 187 and the randomizer then randomized the numbers in such a way that a total of 160 individuals was ultimately chosen as the participants of the study.

The same randomizer was also used for the random assignment of the chosen participants to four equivalent groups under study. To this end, each of 160 participants was first assigned a number from 1 to 160 and the randomizer then randomized these numbers in such a way that the first 40 individuals were assigned to one group, and the second, third, and the fourth 40 participants were put in the other three groups under study. One group served as the pilot group with which the pre-and post-tests of comprehension underwent standardization. The multimedia pre- and post-tests of reading comprehension both comprised 50 questions in the multiple-choice format. The questions, however, were different and hence both tests had to be standardized. Accordingly, all the participants in the pilot group sat at the computer terminals of the computer labs of the researchers' universities and took the tests. There was a short break between the two tests so that exhaustion could not affect the learners' performance on the tests. The participants were required to read 10 academic passages on discipline-specific topics and answer the follow-up compression questions. They had to rely on their prior topical knowledge and contextual guessing strategy to decipher the meanings of unknown keywords and grasp the passages. Each item correctly answered would receive a score of one mark and hence the total possible would be 50. One merit of using multimedia tests of comprehension was that they could automatically log the students' answers, thus facilitating scoring and mean calculation.

Using an item analyzer known as Test Analysis Program (TAP)[2], the researchers then calculated the item statistics of the items of the two tests. There were other alternatives that the researchers could have used such as SIMSTAT[3]; however, what distinguished TAP from other analyzers was that it was capable of marking defective items (those with undesirable IF and ID indexes) with a number sign (#). The analysis revealed that three of the pre-test and one of the post-test items were malfunctioning, as their facility indexes exceeded 0.63, thus falling outside the desirable range. These were then removed and the participants' papers were rescored. All other items had indexes below 0.37 or between 0.37 and 0.63. This was desirable, as this implied that the questions were not easy enough for the participants to get them right without using glossing.

Using SPSS, the researchers then ran an exploratory factor analysis so as to establish the tests' construct validity. The statistical program drew on the Principal Components Extraction technique to ascertain the number of hypothetical factors contributing to the tests' total variance. In so doing, the program extracted all hypothetical factors whose *eigenvalues* fell above unity. Eigenvalue is the amount of variance in the test items accounted for by factors correlating with the test items. In a good test, usually a small number of factors contribute significantly to the total variance of the test, while all other potential variables contribute little or nothing to the test variance. The analysis revealed that 51.24% and 43.32% of the total variance in the pre- and post-tests respectively were accounted for by a single factor. This was promising given the fact that the tests purported to measure a single latent construct. To add strength to the analysis, the statistical program also drew up a scree plot of eigenvalues against the number of factors involved. Figures 1 and 2 below show the scree plots for the pre- and post-tests of reading.

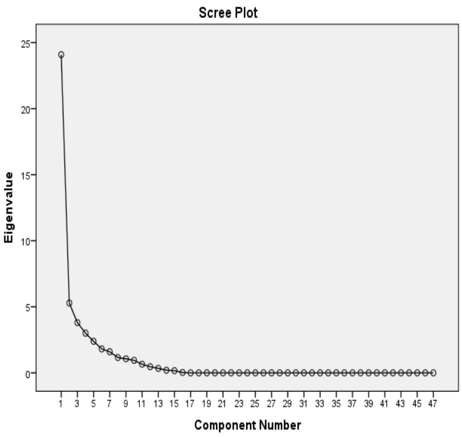


*Figure 1.*Pre-Test Scree Plot

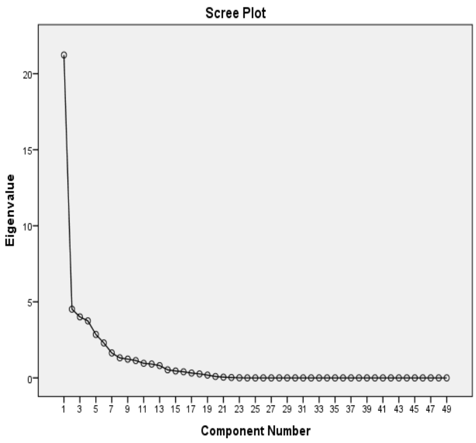


Figure 2. Post-Test Scree Plot

Each of the screes represents a hypothetical factor correlating with the items of the tests. The point at which the screes level off can be deemed as a cut-off point. As can be seen, for both tests, only one scree with an eigenvalue well above unity is on the line with a steep slope, while all other screes are on the straight line. Since their eigenvalues are quite low, this can further corroborate the idea that the tests would measure a single ability.

Once the construct validity of the tests was established, their reliability indexes were computed through a Cronbach's alpha. They turned out to be 0.97 and 0.96 for the pre- and post-tests, respectively. The pre-test was then administered to the three target groups under study. The purpose of pre-testing was twofold: On the one hand, the scores on the test would serve as a criterion against which the efficacy of glossing could be appraised. On the other hand, the means could be compared to determine the homogeneity of the groups in terms of prior topic familiarity and technical knowledge. Like the pilot group, the participants were required to sit at the computer labs and launched the program from the CD. Again, no annotation was used and the students had to rely on the guessing strategy to figure out the meanings of unknown keywords. The use of dictionary was not allowed and all the participants' answers were logged. The countdown timer also controlled the amount of time spent on each text so that all the three groups finish the test at the same time. The mean scores were then calculated and the result of the analysis was reported to the researchers. Tables1through 3 below summarize the result of the pre-test, as well as the Levene test and ANOVA analysis.

Table 1
Means on the Pre-Test

Descriptives	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Group A	40	14.23	2.359	.373	13.47	14.98	10	17
Group B	40	13.33	2.443	.386	12.54	14.11	9	18
Group C	40	13.25	2.262	.358	12.53	13.97	7	17
Total	120	13.60	2.378	.217	13.17	14.03	7	18

Table 2
LeveneStatistic

	df1	df2	Sig.
1.126	2	117	.328

Table 3
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.550	2	11.775	2.122	.124
Within Groups	649.250	117	5.549		
Total	672.800	119			

As can be seen, out of 47 pre-test items, the groups answered a few questions correctly on average. They delivered a poor performance on the test and this suggested that they needed to receive treatment through glossing. Furthermore, a glimpse at the Levene test of equality of variances and ANOVA analysis reveals that all the three groups were homogenous at the beginning of the experiment.

Once the homogeneity of the groups was determined, the students in the experimental groups were assigned to read 10 different academic reading passages at the researchers' signal. All the students then placed the programs' CDs in their PCs' CD/DVD-ROM drives and launched the programs. Once inserted, an embedded robot guide embarked on a brief introduction as to how the groups could interact with the glosses and how they could answer the following questions. Next, the two groups received treatment on the texts under one of two conditions: One experimental group receive treatment on the reading passages through a multimedia environment where they could interact with textual glosses to surmise the meanings of keywords. Upon moving the mouse cursor, a textual definition would pop up on the screen and the participants' use of glosses was then logged using Action Script programming. The students' interaction with glosses was recorded, as it would help the researchers determine the frequency with which the participants used annotation and approached the post-test comprehension questions. The question templates appeared on the top of the main frame, while the passages appeared at the bottom. This would allow simultaneous reading and attempting the test questions. As for the second experimental group likewise, the students received treatment on the same passages, but used compound glosses where both a pictorial and a textual definition of words would pop up upon the movement of the mouse cursor. Figures 3 through 6 below show the programs' interface for the two experimental groups under study.

Figure 3. The Login Page

Figure 4. The Robot Guide

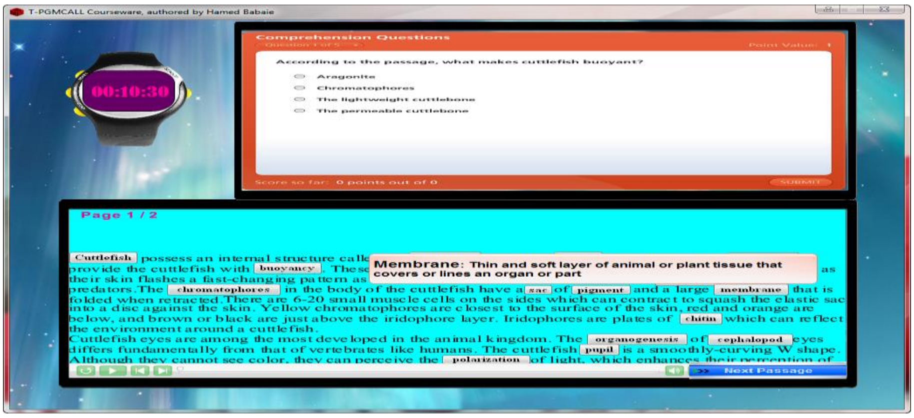


Figure 5. The Textual Gloss

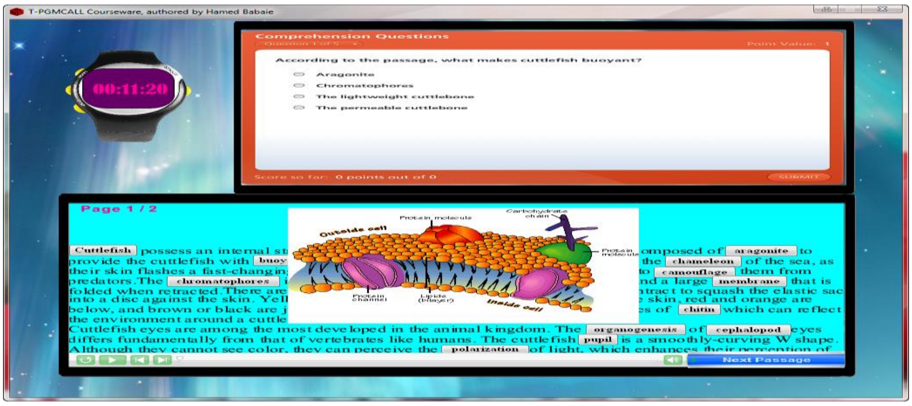


Figure 6. The Compound Gloss

While the participants were reading the multimedia passages, the frequency with which they used glossing, or the guessing strategy or their prior knowledge of the keywords was also recorded for later analyses. Tables 4 and 5below display the frequency counts for gloss use in the two multimedia settings.

Table 4
Frequency Count for Textual Gloss

Frequency / Student	Number of textual glosses not used	Number of textual glosses used	Total number of annotated keywords
1	20	133	153
2	10	143	
3	13	140	
4	29	124	
5	41	112	
6	5	148	
7	0	153	
8	39	114	
9	51	102	
10	32	121	
11	22	131	
12	29	124	
13	11	142	
14	8	145	
15	1	152	
16	3	150	
17	14	139	
18	20	133	
19	11	142	
20	8	145	

21	16	137
22	17	136
23	23	130
24	34	119
25	45	108
26	21	132
27	11	142
28	18	135
29	21	132
30	31	122
31	17	136
32	1	152
33	5	148
34	7	146
35	19	134
36	24	129
37	32	121
38	11	142
39	15	138
40	19	134
Mean	18.85	134.15

Table 5
Frequency Count for Compound Gloss

Frequency / Student	Number of compound glosses not used	Number of compound glosses used	Total number of annotated keywords
1	4	149	153

2	10	143
3	22	131
4	25	128
5	3	150
6	45	108
7	43	110
8	53	100
9	1	152
10	4	149
11	3	150
12	36	117
13	43	110
14	32	121
15	3	150
16	0	153
17	13	140
18	24	129
19	34	119
20	23	130
21	12	141
22	10	143
23	32	121
24	4	149
25	6	147
26	4	149
27	17	136
28	9	144
29	23	130
30	44	109
31	21	132

32	23	130
33	11	142
34	16	137
35	11	142
36	25	140
37	23	130
38	39	114
39	42	111
40	56	97
Mean	21.23	132.08

As can be seen in the tables, the students in both groups made a considerable use of glosses in attempting the comprehension questions on average and made a little use of guessing or relied on their technical knowledge if any. While the experimental groups reaped benefit from glossing, students in the control group had to rely on the guessing strategy in reading the passages. Here the participants had to process the texts for contextual cues, drawing heavily on neighboring words so as to guess the meanings of key vocabularies.

The experiment lasted for approximately 70 minutes where the participants spent seven minutes reading each text fragment and attempting the follow-up comprehension questions. For the experimental groups, the built-in timer, and for the control group, the teacher himself controlled the time for the test. To explore whether glossing proved fruitful in gaining a better understanding of the passages on the learners' part, the next step involved the examination of the participants' scores on the post-test of reading comprehension.

Results

Tables 6 through 9 below show the results of the analysis of the post-test means, the Levene and ANOVA statistics, as well as the Scheffé test.

Table 6
Means on the Post-Test

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Group A	40	39.08	6.545	1.035	36.98	41.17	20	49
Group B	40	44.80	4.189	.662	43.46	46.14	33	49
Group C	40	15.25	3.643	.576	14.09	16.41	4	21
Total	120	33.04	13.757	1.256	30.56	35.53	4	49

Table 7
Levene Statistic

	df1	df2	Sig.
2.316	2	117	.103

Table 8
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19648.117	2	9824.058	400.120	.000
Within Groups	2872.675	117	24.553		
Total	22520.792	119			

Table 9
SchefféTest

(I) Exp. Groups	(J) Exp. Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-5.725	1.108	.000	-8.47	-2.98
	C	23.825	1.108	.000	21.08	26.57
B	A	5.725	1.108	.000	2.98	8.47
	C	29.550	1.108	.000	26.80	32.30
C	A	-23.825	1.108	.000	-26.57	-21.08
	B	-29.550	1.108	.000	-32.30	-26.80

As shown in Table 6, the mean scores on the post-test varied significantly for the two experimental groups as compared with the pre-test means, but for the control group, the gain was not dramatic. This is typical, as the control group received no special treatment on the academic passages and used no any other strategy but contextual guessing. The table further reveals the experimental group (Group B) who used compound glosses outperformed the other group (Group A) who used textual glosses on the post-test of reading. Given the heterogeneity of all the three groups at the end of the experiment, it is suggested, therefore, that a combination of textual and pictorial definitions of technical vocabulary might prove more beneficial in aiding efficient encoding, memory, and hence comprehension of L2 texts. Yet due to sparseness of research on the contribution of multimedia glossing to language learning, in general, and L2 texts reading comprehension, in particular, further studies are required to substantiate such claims.

Discussion

The present study sought to find an empirically justified answer to the following questions:

1. Is there any statistically significant difference in the use of multimedia glosses and contextual guessing in aiding L2 reading comprehension skills?

2. Is there any statistically significant difference in the use of textual glosses and compound glosses in aiding L2 reading comprehension skills?

The answer to the first question is "yes" in favor of glossing, as the experiment revealed that both experimental groups who received treatment on the passages through glossing outperformed the control group who drew heavily on the guessing strategy. One explanation is that guessing from context might have an adverse effect on the short-term memory in the long run, where it should be used primarily for processing chunks of reading passages rather than individual keywords. In other words, when utilizing the strategy, a great amount of attention is diverted to processing neighboring words, thus overloading the working memory capacity, leaving little room for the analysis of passage fragments. This argument seems to favor Moreno and Mayer's (2002 as cited in Babaie, 2008) Cognitive Load Theory (CLT) which suggests that working memory where all conscious cognitive processing occurs can handle only a very limited number, at most three, of novel interacting elements. According to Pass, Renkl, and Sweller (2003), there is a continuum along which information varies from low to high in *element interactivity*. They argue that low-element interactivity material is more likely to be processed readily by the working memory thanks to lesser degrees of interaction among different elements in the input. Accordingly, when there is little interaction among different elements, a greater portion of the working memory capacity can be allocated to processing higher-order components. When applied to reading comprehension, the idea seems to suggest that comprehension, by nature, involves processing high-element interactivity martials in the input which per se places an added burden on the reader's mind to not only process the individual words but also the whole chunks so as to arrive at a relative understanding of the text. Therefore, when guessing is repeatedly utilized, element interactivity would be high enough to overload the working memory capacity where high levels of attention is devoted to processing co-texts for the understanding of both individual words and chunks concurrently. When compared with glossing, however, the findings of this study seem to corroborate the idea that glossing may reduce cognitive load by providing the students with immediate and ready access to words meanings in a fracture of a second. One ramification of this is that a greater portion of the working memory capacity would, then, be allocated to processing higher-order comprehension skills than individual keywords in the reading texts. In other words, the researchers believe that glossing has the potential to reduce the amount of interaction among elements in the input by allowing students to focus primarily on processing chunks in reading passages, thus gaining a more efficient and deeper understanding of the texts. Moreover, the efficiency of glossing can best be ascribed to its unobtrusiveness as aptly favored by Davis (1989) when he argues that students are less likely to be disrupted by glosses, largely owing to the fact that they can readily access words meanings upon a simple mouse click, while still having the flow of information in mind to be processed. While all these assumptions may hold, further studies are needed to corroborate these views.

As of the second question, the present study also revealed that the experimental group (Group B) who used compound glosses outperformed the one (Group A) who received textual glosses while reading the texts. One rationale is that visuals are more readily remembered than are words. Thanks to their persistence in the working memory, it is likely that visual pieces of information are more readily transferred to the long-term memory. Accordingly, learners might arrive at a deeper understanding of the passages as they keep the key meanings in memory without losing their train of thoughts. This seems to underpin Underwood's (1989, p. 19) idea when he argues that "[a] commonplace principle of human learning is visual memory. We remember images better than words. Hence, we remember words better if they are strongly associated with images". Some studies (Al-Seghayer, 2001; Babaie, 2010; Denis, 1982 as cited in Chun &Plass 1997; Iheanacho, 1997; Johnson-Glenberg, 2000; Paivio, Smythe, &Yuille, 1968) have corroborated this view. Another justification is that visuals might help learners better decipher the meanings of keywords in reading passages. As Babaie (2010) argues, visuals, in antithesis to textuals, are more elaborate in nature, and hence might better reveal to learners the underlying concepts with which words are associated. When applied to reading comprehension, students might, then, arrive at an even better understanding of reading passages, as the meanings of keywords are more effectively revealed to them. More studies, however, are required to substantiate such claims. Still another explanation is that pictures can serve as effective attention-getting devices. According to Day (1982), visuals have the potential to arouse students' curiosity as they attempt to analyze the concepts with which they are associated. This stimulation of curiosity might, then, more effectively focus learners' attention on the subject matter being introduced, which in the long run might lead to an even more effective acquisition of information. When applied to reading comprehension, the researchers of the present study contend that increased levels of attention to keywords can persist in learners' working memory, thus making the associated meanings more memorable. Consequently, as students more readily keep track of the meanings in their memory, they may arrive at an even deeper undertraining of the passages.

Finally, it can be contended that a combination of both textual and pictorial definitions might even better reveal the underlying meanings to learners. This added elaboration might, then, lead to an even deeper understanding of the reading passages. In other words, the association that occurs between the textual and visual representations of keywords in the working memory makes the associated meanings even more memorable. When students quickly access the meanings in their memory, they might arrive at an even deeper understanding, as they can now more concentrate on the main ideas rather than the meanings themselves. The idea confirms Paivio's (1971, 1986) Dual Coding Theory which contends that pictures and words activate different visual codes known as *imagens* and verbal codes called *logogens* in the visual and verbal memories respectively. It is further hypothesized that three types of processes occur between these two memory modules and within each system. The first type is the *representational processing* that takes place between the incoming stimuli and the verbal or visual memory. For instance, seeing or hearing the term "scissors" will activate the corresponding verbal code (scissors) in the verbal system, while seeing the picture of this tool will readily activate the pertinent imagen in the visual memory. The second type of these processes, the *referential processing*, occurs between the verbal and visual memories. For instance, seeing or hearing the term “scissors” will activate the relevant logogen in the verbal memory, and this will in turn activate the corresponding imagen in the visual memory. The reverse is also true. Seeing the picture of a scissors will ultimately activate the logogen of the tool in the verbal memory. Finally, the third type, the *associative processing*, refers to the processing of information within each memory module. For instance, within verbal memory, a logogen like “head” might be associated with a number of other logogens like “skull”, “mind”, “chief”, and so on in different contexts. A previously activated logogen might, then, help activate other logogens associated with it (Sadoski & Paivio, 2004).

Accordingly, the dual coding of words might aid vocabulary learning, as pictures are more readily retrieved from memory than are words (Paivio, 1986), and the likelihood of recalling the words increases thanks to their being associated with pertinent pictures in the visual memory (Schmitt, Tavassoli, & Millard, 1993; Unnava & Burnkrant, 1991). When applied to reading comprehension, it can be argued that the combination of textual and visual information makes keywords more elaborate and thus more memorable. The meanings of the keywords are, then, more readily retrievable as learners go through the reading passage. This ease of access will lead to a deeper understanding in the long run, as students more effectively concentrate on the main ideas without losing their train of thoughts. Still another explanation is that when two memory modules are addressed instead of one, cognitive load is comparatively lower as compared with cases when either memory module is addressed (Baddeley, 1997; Sweller, Van Merriënboer, &Paas, 1998). This frees up an even greater amount of the working memory capacity for processing higher-order comprehension skills. Presumably, the more capacity is allocated to comprehension processes, the deeper the understanding of the passage. Notwithstanding, further studies are required to corroborate these assumptions.

Conclusion and Implications

In this experiment, compound glosses proved more fruitful in aiding learners' reading comprehension. This suggests that the traditional guessing technique be supplanted by multimedia glosses of this type so that learners are able to readily access the meanings of words and thus free up their memory's capacity for higher-order comprehension skills. ELT teachers and enthusiasts can, then, author customizable pieces of TELL courseware incorporating reading passages whose keywords are annotated through compound glosses to aid both vocabulary acquisition and reading comprehension.

Notes

1. http://www.supercoolbookmark.com/download/supercoolrandom104.zip
2. http://www.provalisresearch.com/simstat.php
3. http://www.provalisresearch.com/simstat.php

References

Akbulut, Y. (2008). Predictors of foreign language reading comprehension in a hypermedia reading environment. *Journal of Educational Computing Research*, *39*(1), 37-50.

Al-Seghayer, K. (2001). The effect of multimedia annotation modes on L2 vocabulary acquisition: A comparative study. *Language Learning & Technology*, *5*(1), 202-32. Retrieved October 10, 2011, fromhttp://llt.msu.edu/vol5num1/alseghayer/default.pdf

Babaie, H. (2008). On the effects of help options in MCALL programs on the listening comprehension of EFL learners. *Journal of TELL*, Tarbiat Modares University, 2(6), 27-47.

Babaie, H. (2010). Image modalities in multimedia vocabulary instruction: Does dual coding of vocabulary occur at different degrees? *Journal of English Language Studies (JELS)*, Islamic Azad University-Central Tehran Branch, *1*(2), 83-102.

Bachman, L. F., & Palmer, A. S. (1996). *Language testing in practice*. Oxford: Oxford University Press.

Baddeley, A. D. (1997). *Human Memory: Theory and practice.* Hove, United Kingdom: Psychology Press.

Bengeleil, N., & Paribahkt, T. S. (2004). L2 reading proficiency and lexical inferencing by university EFL learners. *Canadian Modern Language Review*, *61*, 225-49.

Birjandi, P., Mosallanejad, P., & Bagheridoust, E. (2006). *Principles of teaching foreign languages*. Tehran: Rahrovan Publications.

Bowles, M. A. (2004). L2 glossing: To CALL or not to CALL. *Hispania*, *87*(3), 541-52.

Brown, D. (2001). *Teaching by principles: An interactive approach to language pedagogy* (2nd Ed.). White Plains, Addison: Welsey Longman, Inc.

Chastain, K. (1988). *Developing second language skills: theory and practice.* Florida: Harcourt BracJovanish, Inc.

Cheng, Y. (2009). L1 glosses: Effects on EFL learners' reading comprehension and vocabulary retention. *Reading in a Foreign Language, 21*(2), 119–42.

Chun, D. M., & Plass, J. L. (1997). Research on text comprehension in multimedia environments. *Language Learning & Technology*, *1*(1), 60-81.

Davis, J. N. (1989). Facilitating effects of marginal glosses on foreign language reading. *The Modern Language Reading*, *73*(1), 41-52.

Day, I. (1982). Curiosity and the interested explorer: *Performance and instruction*, *21*(4), 19-22.

Gardner, D. (2011). *Fostering autonomy in language learning*. Gaziantep: Zirve University.

Gettys, S., Imhof, L. A., &Kautz, J. O. (2001). Computer-assisted reading: The effect of glossing format on comprehension and vocabulary retention. *Foreign Language Annals*, *34*, 91-106.

Hong, Xu. (2010). Review of effects of glosses on incidental vocabulary learning and reading comprehension. *Chinese Journal of Applied Linguistics*, *33*(1), 56-72.

Iheanacho, C. C. (1997). Effects of two multimedia computer-assisted language learning programs on vocabulary acquisition of intermediate level ESL students. Dissertation Abstracts International, Section A: The Humanities and Social Sciences, *62*(8) (UMI No. 3024746)

Johnson-Glenberg, M. C. (2000). Training reading comprehension in adequate decoders / poor comprehenders: Verbal versus visual strategies. *Journal of Educational Psychology*, *92*(4), 772-82.

Jones, L. & Plass, J. (2002). Supporting listening comprehension and vocabulary acquisition in French with multimedia annotations. *The Modern Language Journal*, *86*(4), 546-61.

Ko, M. H. (2005). Glosses, comprehension, and strategy use. *Reading in a Foreign Language*, *17*(2), 125-143. Retrieved September 10, 2011, from http://nflrc.hawaii.edu/rfl/October2005/ko/ko.pdf

Lee, K. R., & Oxford, R. (2008). Understanding EFL learners' strategy use and strategy awareness. *Asian EFL Journal*, *10*(1), 1-19. Retrieved November 2, 2011 from http://www.asian-efl-journal.com/March_08_kl&ro.php

Lomicka, L. L. (1998). To Gloss or not to gloss: An investigation of reading comprehension online. *Language Learning & Technology*, *1*(2), 41-50. Retrieved October 21, 2011, from http://llt.msu.edu/vol1num2/pdf/article2.pdf

Martinez-Lage, A. (1997). Hypermedia technology for teaching reading. In M. D. Bush, R. Terry (Eds.), *Technology Enhanced Language Learning* (pp.121-63). Lincolnwood, IL: National Textbook Company.

Nation, I. S. P. (2001). *Learning vocabulary in another language.* Cambridge: Cambridge University Press.

Nunan, D. (1999). *Second Language Teaching and Learning* (2nd Ed.). London: Heinle & Heinle Publishers.

Pass, F., Renkl, A., & Sweller, J. (2003). Cognitive Load Theory and instructional design: Recent developments. *Educational Psychologist*, *38*(1), 1-4.

Pigada, M., & Schmitt, N. (2006). Vocabulary acquisition from extensive reading: A case study. *Reading in a Foreign Language, 18*,1-28.

Paivio, A., Smythe, P. C., & Yuille, J. C. (1968). Imagery versus meaningfulness of noun in paired-associated learning. *Canadian Journal of Psychology*, *22*, 427-41.

Paivio, A. (1971). *Imagery and Verbal Processes*, New York: Holt, Rinehart, and Winston.

Paivio, A. (1986). *Mental Representations: A Dual Coding Approach*, New York: Oxford University Press.

Plakans, L. (2009). The role of reading strategies in integrated L2 writing tasks. *Journal of English for Academic Purposes8*, 252-66.

Roby, W. B. (1999). What's in a gloss? *Language Learning & Technology*, *2*(2), 94-101. Retrieved October 10, 2011, from http://www.polyglot.cal.msu.edu/llt/vol2num2/roby/index.html

Rott, S., & Williams, J. (2003). Making form-meaning connections while reading: A qualitative analysis of word processing. *Reading in a Foreign Language, 15*(1), 45-75. Retrieved September 20, 2011, from http://nflrc.hawaii.edu/rfl/April2003/rott/rott.pdf

Sadoski, M., & Paivio, A. (2004). A dual coding theoretical model of reading.In R. B. Ruddell& N. J. Unrau (Eds.), *Theoretical models and processes of reading (5th ed.)*(pp. 1329-62). Newark, DE: International Reading Association.

Schmitt, B., Tavassoli, N., & Millard, R. (1993). Memory for print ads: Understanding relations among brand name, copy, and picture. *Journal of Consumer Psychology*, *2*(1), 55-81.

Stein, M. (1993). The healthy inadequacy of contextual definition. In T. Huckin, M. Haynes, & J. Coady (Eds.), *Second language reading and vocabulary learning* (pp. 203-12). Norwood, NJ: Ablex.

Stewart, R. A., & Cross, T. L. (1991). The effect of marginal glosses on reading comprehension and retention. *Journal of Reading, 35,* 4-12.

Sweller, J., Van Merriënboer, J. J. G., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10,* 251-96.

Unnava, H., & Burnkrant, R. (1991). An Imagery-Processing View of the role of pictures in print advertisements. *Journal of Marketing Research*, *28(*2). 226-31.

Yanguas, I. (2009). Multimedia glosses and their effects on L2 text comprehension and vocabulary learning. *Language Learning & Technology*, *13*(2), 48-67.

Yoshii, M. (2006). L1 and L2 glosses: Their effects on incidental vocabulary learning. *Language Learning & Technology*, *10*(3), 85-101. Retrieved October 22, 2011, from http://llt.msu.edu/vol10num3/yoshii/

Zaid, M. A. (2009). Comparison of inferencing and meaning-guessing of new lexicon in context versus non-context vocabulary presentation. *The Reading Matrix*, *9*(1), 56-66.

Appendix

Software Development Process

This part may be of interest to those enthusiasts who are willing to replicate the present study. The overriding focus here is to explain the procedure taken in authoring the multimedia courseware in the most clear, unequivocal way so that even non-expert enthusiasts could reap much benefit from the guidelines suggested. One of the researchers undertook the task of authoring the multimedia programs. The main software he used to build the pieces of courseware under study is called Swish Maxthat features a user-friendly interface. The program is the counterpart of Adobe Flash CS5, the most sophisticated flash movie builder worldwide. Sothink SWF Quicker is another alternative, albeit it comes with fewer gadgets. Each one of the three programs can be used to author interactive, flash-based multimedia programs, depending on the dexterity of the designer. The flash movie file produced by the aforementioned pieces of software can then serve as a frame onto which different multimedia components, such as visuals, special effects, passage and question templates, countdown timer, and so on are loaded. Other third party applications that can be used to build the multimedia components are as follows:

1. **Bluff Titler:** If you want to build an intro movie, introducing your software to students, this program may come in handy. Using stunning visual effects, the program can best capture your students' attention before instruction.
2. **Insofta 3D Text Commander:** It is essential that each student input their personal information, including their names, field of study, and so on into the required fields in the programs' interface. Their personal information will, then, form their profiles where their scores on comprehension tests are stored. Text Commander can, then, be used to label these required fields.

3. **ACD See:** A renowned image-processing piece of software for editing visuals, this application can be used to modify the images used as pictorial glosses in the multimedia programs. Images should be trimmed to fit the main frame onto which multimedia components are loaded. Too bright or too dark images should be adjusted for the best visibility.

4. **Crazy Talk:** A good multimedia program should incorporate a guide in the form of an anthropomorphic or non-anthropomorphic agent that guides learners during the instruction process. A study by Babaie (2008) favored the use of multimedia agents as effective attention-getting devices that can focus learners' attention on the salient linguistic features and discourse paradigms of language. Crazy Talk can, then, be used to author such animated agents.

5. **Text Aloud:** The agent should talk to the students. Text-to-speech software like this can enable the designer to convert his/her desired text into voices of different types and then use Crazy Talk to synchronize the output voice with the agent.

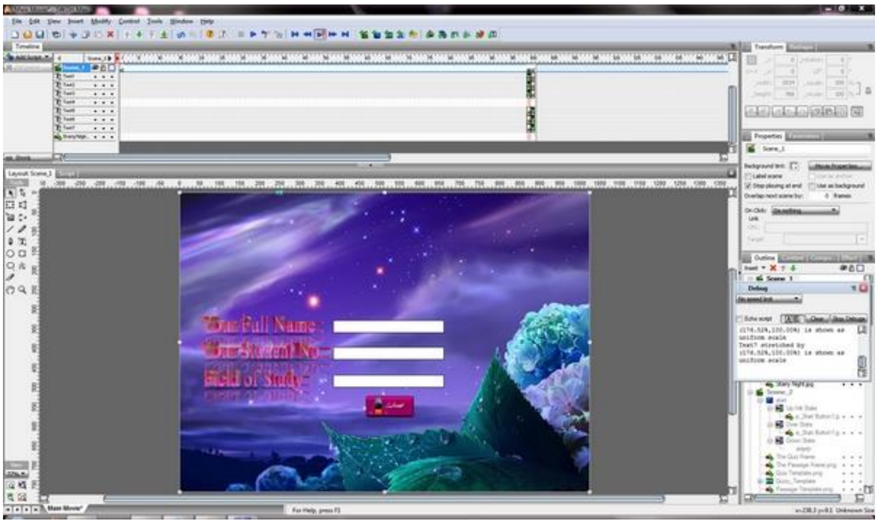
6. **Adobe Captivate:** Experience shows that if a number of multimedia components in flash-based multimedia programs are loaded simultaneously into memory within the same frame, performance will be significantly reduced. In order to have the program run smoothly, it should be modular, which means that it should first load the main frame into memory. The frame will then load the multimedia components into their appropriate frames one by one so that memory resources are not overloaded. Adobe Captive can, then, produce independent, standalone, flash-based multimedia passages that can be loaded by the main movie one by one.

7. **Articulate Quizmaker:** This program is used to author multimedia comprehension questions based on the passages built. Using "shared objects", which operate like "cookies", the program calculates students' scores and store them in a log file on the hard drive.

8. **Agma Web Buttons:** Using this program, the designer can build customized buttons to be embedded in the main frame. These buttons are primarily used by the students to move on to the next passages.

The very first step in authoring the multimedia programs under the study involves building a main frame. In so doing, we first launch Swish Max to access the programs' interface. Once the program is launched, we can then identify "scenes" representing the number of main frames we wish to include in the programs. For instance, if we wish our courseware would comprise 10 multimedia reading passages, then we will need to identify 10 scenes or main frames onto which these passages are loaded. If our programs are coupled with an intro movie and an agent too, then the first two scenes should load these two multimedia components, while any subsequent scenes should load the passages. The intro movie can be built using Bluff Titler, provided the designer has some good command of animation. The intro screen informs the students of what the program is about, and if nicely built, can capture their attention. Increased levels of motivation may, then, help learners more effectively concentrate on the subject matter. Once built, the program saves the movie file in one of the popular formats, such as MPEG video or DivX movie. The resulting output can then interact with the main frame through Action Script programming. This means that while the movie file is stored in a single folder on the hard drive or CD-ROM, we can use script codes to have the main frame (scene) load the intro movie at the appropriate frame when necessary.

In the next step, we should have the program load the login page into the second frame (scene). The login page may look like this:



The login page is used to get learners' personal information and store them in a shared object somewhere on the hard drive. The following codes can be used to serve this purpose:

```
onFrame (1)
{
playSound("LoginPageMusic");
var user = SharedObject.getLocal("user_profile");
if (user.data.Text1 == undefined)
{
gotoSceneAndPlay("Scene_1", 1);
}
else
{
Name = user.data.Text1;
Candidate_No = user.data.Text2;
Field_of_Study = user.data.Text3;
gotoSceneAndPlay("Scene_1", 100);
}}
onFrame (99) {
stop();
}
onFrame (100) {
playSound("LoginSuccessful!");
LoginPage.unloadMovie();
   Message4 = "Login Successful!"
   Message5 = Name;
```

```
    Message6 = Candidate_No;
    Message7 = Field_of_Study;
var nDelayID0:Number = setInterval(this, "pause0", 8000);
function pause0():Void {
clearInterval(nDelayID0);
gotoSceneAndStop("Scene_2", 1);
}}
```

The expression “if (user.data.Text1 == undefined)” will check whether or not the student had previously entered his personal information. If this is the case, the program will then go to the next frame (here frame 100) and display the student’s information. In case the student had not previously entered his personal information, the code will tell the program to stop at frame (1) where, as shown in the picture above, he can enter his personal information. When the student clicks on the “Submit” button below, the program stores the required details in a log file and then moves on to the next scene where the agent will then guide the learner during the instruction:

The agent can be built using Crazy Talk. Designers can use a static image of a robot and then have the program animate it like a human being. Yet any other anthropomorphic or non-anthropomorphic agents can serve the purpose, too. Once built, we should have the next frame load the guide, as well as sample passage and question templates into memory. This can be accomplished through the following codes:

```
onFrame (1) {
  _root.start._visible = false;
stopSound("LoginPageMusic");
var nDelayID0:Number = setInterval(this, "pause0", 2000);
function pause0():Void {
clearInterval(nDelayID0);
stop();
stopAllSounds();
TheRobotGuide.loadMovie("TheGuide/TheRobotGuide.swf");
}}
onFrame (1) {
var nDelayID1:Number = setInterval(this, "pause1", 45000);
function pause1():Void {
clearInterval(nDelayID1);
gotoSceneAndPlay("Scene_2", 1)
}}
onFrame (50) {
stop();
}
onFrame (1) {
var nDelayID2:Number = setInterval(this, "pause2", 48000);
```

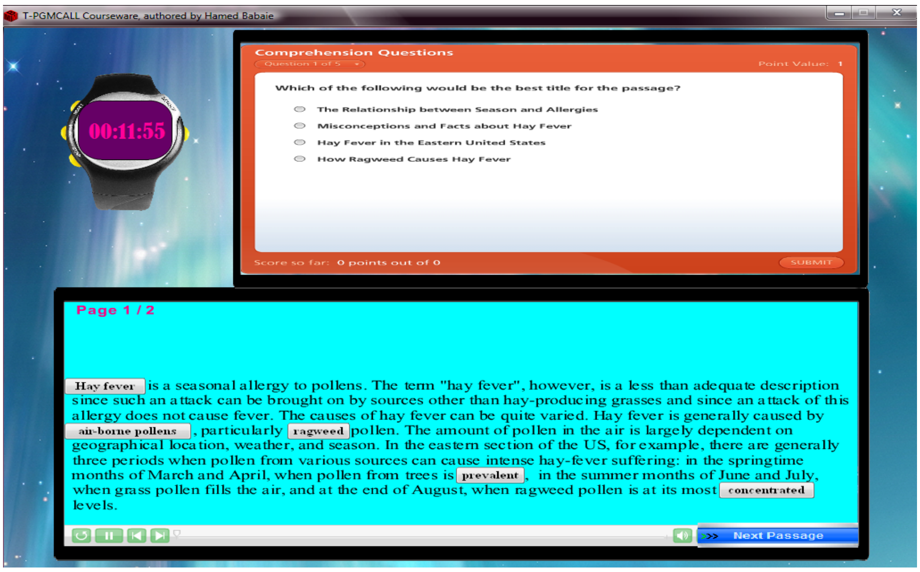
```
function pause2():Void {
clearInterval(nDelayID2);
gotoSceneAndPlay("Scene_2", 50)
}}
onFrame (100) {
stop();

Quizz_Template.loadMovie("QuizTemplate/qtr.swf");
Passage_Template.loadMovie("PassageTemplate/ptr.swf");
}
onFrame (1) {
varDelay:Number = setInterval(this, "delaystart", 88000);
functiondelaystart():Void {
clearInterval(Delay);
_root.start._visible = true;}}
```

The expression “The Robot Guide. load Movie("The Guide/TheRobotGuide.swf");” will load the robot guide from a local folder, “The Guide”, into the main frame. Likewise, the expressions “Quizz _ Template. load Movie("Quiz Template/qtr.swf");” and “Passage _ Template. load Movie("Passage Template/ptr.swf");”will tell the program to load the sample passage and question templates we built using Adobe Captivate into the main frame so as to guide learners how to use the glosses and approach the tests.

Next, we should have the program load the multimedia passages and the question banks into subsequent frames when students click on the “Start!” button. In this step, we first use Adobe Captivate to build the passages and Articulate Quizmaker to build the comprehension questions. For the multimedia program using compound glosses, we should find both appropriate definitions and pertinent images, and embed them in the passages so that when students move the mouse cursor over the keywords, a combination of both textual and pictorial annotations pop up on the screen. Then we use the quiz builder to formulate our questions in the multiple choice format. We can specify the correct answer to each question and then have the quiz builder assign one mark to each correctly answered question. Once we have built our passages and question banks, we can then have any subsequent scenes load the passage and question templates into appropriate frames.

In order to control the amount of time spent on each passage, each program should come with a countdown timer. To build the timer, we should first find an image of a clock. The middle part of the image should then be modified to include a rectangular frame showing the time limit. This can be done using ACD See or Adobe Photoshop. Next, we should draw a dynamic text box in each scene whose content changes dynamically. Indeed, three types of texts can be identified in flash-based programs: Static text whose content is static, dynamic text whose content is changeable by the program itself, and input text whose content can be changed by the user. Since the programs themselves should control the amount of instruction, the specified text box should be of dynamic type. The following image shows the frame containing a countdown timer:



The following code can, then, tell the program how and when to run the timer once the passage and question templates are loaded into the main frame:

```
onFrame (21) {
stopSound("FinalMusic")
stopSound("Passage 2")
stopSound("Passage 3")
stopSound("Passage 4")
stopSound("Passage 5")
playSound("Passage 1");
stop();
var nDelayID1:Number = setInterval(this, "pause1", 2000);
function pause1():Void {
clearInterval(nDelayID1);
}
var nDelayID2:Number = setInterval(this, "pause2", 2000);
function pause2():Void {
clearInterval(nDelayID2);
}
varDelay:Number = setInterval(this, "delaystart", 2000);
functiondelaystart():Void {
clearInterval(Delay);
}
var nDelayID13:Number = setInterval(this, "pause13", 2000);
function pause13():Void {
clearInterval(nDelayID13);
}
_root.message1._visible = false;
_root.warning._visible = false;
_root.yes._visible = false;
_root.no._visible = false;
```

```
start_time = getTimer();
countdown = 720000;
onEnterFrame = function () {
elapsed_time = getTimer()-start_time;
_root.count_down1.text = time_to_string(_root.countdown-
elapsed_time);
}
functiontime_to_string(time_to_convert) {
elapsed_hours = Math.floor(time_to_convert/3600000);
remaining = time_to_convert-(elapsed_hours*3600000);
elapsed_minutes = Math.floor(remaining/60000);
remaining = remaining-(elapsed_minutes*60000);
elapsed_seconds = Math.floor(remaining/1000);
remaining = remaining-(elapsed_seconds*1000);
elapsed_fs = Math.floor(remaining/10);
if (elapsed_hours<10) {
hours = "0"+elapsed_hours.toString();
} else {
hours = elapsed_hours.toString();
}
if (elapsed_minutes<10) {
minutes = "0"+elapsed_minutes.toString();
} else {
minutes = elapsed_minutes.toString();
}
if (elapsed_seconds<10) {
seconds = "0"+elapsed_seconds.toString();
} else {
seconds = elapsed_seconds.toString();
}
if (elapsed_time> 719999) {
_root.count_down1._visible = false;
_root.message1._visible = true;
} else {
return hours+":"+minutes+":"+seconds;
}}
var nDelayID3:Number = setInterval(this, "pause3", 726000);
```

```
function pause3():Void {
clearInterval(nDelayID3);
Quizzes.unloadMovie();
Passages.unloadMovie();
gotoSceneAndPlay("Scene_3", 22)
}
var nDelayID4:Number = setInterval(this, "pause4", 732000);
function pause4():Void {
clearInterval(nDelayID4);
gotoSceneAndStop("Scene_4", 21);
}}
onFrame (22){

stopAllSounds();
}
onFrame (56){
gotoSceneAndPlay("Scene_3", 22)
}
```

The time is expressed in millisecond. 1000 milliseconds equal one second. Likewise, 60000 milliseconds equal one minute. If, for instance, we want to count down from 12 minutes, then we need 720 seconds or 720000 milliseconds to elapse. Accordingly, in the expression "countdown =" we should identify the value 720000. The expression "if (elapsed_time> 719999)" will tell the program what to do once the limit has reached. One of the jobs the program will do when the limit reaches is that it will automatically unload the current passage and question templates so that the students will not be able to luxuriously wok on the passages.