

# Joint Bell Labs – ACU Usability Study of a Digital Book Interface

by

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## Introduction.

This report describes the results of usability studies of an electronic book with a social component which has been created through the joint efforts of Bell Labs, Abilene Christian University, and Cambridge University Press. The purpose of this report is to assist designers and engineers in the design of the e-book.

Following a brief review of the methodology of the studies, the results are presented in three sections. The Section 1 describes the results concerning the frequency of use of various annotations. Section 1 contains the findings of the annotation tasks using the iPad and paper. This section also contains analysis of annotation frequency which compare the tasks and the groups. Section 2 describes the data from interview questions and tasks which asked the students to identify preferred names and symbols for annotations. Section 3 contains a brief analysis data about the the social elements of the e-book.

## Methodology.

These usability studies were conducted jointly by Bell Labs and Abilene Christian University on the campus of Abilene Christian University (ACU). ACU students participated in the studies. The students were recruited from various majors and classifications.

The students were asked to participate in four tasks. Two of the tasks required the student to interact with a prototype version of the e-book. The students' actions were recorded in video and audio using the Morae software. Observations of the students actions were coded by the research staff using the Morae software. The tasks and subsequent interview questions were administered by Bell Labs and ACU researchers.

An important component of the data collection was the use of the Morae Observer module which allowed the researchers to place markers in the audio and video recordings. The data described in this report were derived by using the Morae analysis capability. Tables in this report which are based on the marker data used the coding system described in Table 1.

Table 1: Coding of annotations in marker data.

Code	Significance
C	Conversation
H	Highlight
I	Interpretation
N	Note

O	Others annotations
S	Summary
U	Underline
X	Symbols

Students who participated were recruited as a sample of convenience with an effort to achieve diversity in gender, field of study, and the classification. An additional criterion was that the student was sufficiently articulate to be able to fully participate in the interview and in the think-aloud portions of the studies. Eighteen students participated in the studies. The data for one student was lost due to a power outage. For two additional students the data one study, either Task 1 or Task 2 were lost.

The students were randomly divided into two groups. One group used the “social” version of the e-book (“social” group) The other group used a version of the e-book which did not include the social component (“not social” group). Eight students were assigned to the social group and 10 to the not social group. The student for whom both Task 1 and Task 2 data were lost was in the social group. Consequently, the social group had seven students and the not social group had 10.

### **Section 1: Frequency of annotations used**

This section includes four parts. The first three parts describe the students’ annotations and interview responses for Task 1, Task 2, and Task 3. The fourth part describes various analysis comparing the frequency of annotations by task and by group.

#### Annotation use in Task 1

Table 2 contains the frequency of use of each of the annotation categories for the task which asked students to annotate the iPad version of a text from which they would write a paper. The primary point of interest here is the relative frequency with which the students selected the various annotation options. The shaded row shows that the use of highlighting, underlining, and symbols predominate.

Table 2: Frequency of use of various annotations on iPad in Task 1 – write a paper – based on marker data from Morae

	Group	C	H	I	N	O	S	U	X	Task 1 Totals
Subj 17	1									
Subj 11	1	0	6	0	4	1	0	2	2	15
Subj 15	1	0	11	0	2	5	0	0	1	19
Subj 5	1	0	8	0	0	0	0	0	1	9
Subj 6	1	0	9	2	3	0	0	7	2	23
Subj 7	1	0	5	1	0	2	0	1	0	9
Subj 8	1	1	9	1	4	0	0	7	15	37
Subj 12	2	0	4	0	0	0	0	2	2	8
Subj 1	2	0	2	0	2	0	0	0	0	4
Subj 10	2	0	6	0	1	0	0	0	0	7
Subj 11	2	0	29	0	0	0	0	0	0	29
Subj 14	2	0	8	0	0	0	0	1	0	9
Subj 16	2	0	5	2	2	0	3	2	4	18
Subj 2	2	0	5	0	1	0	0	7	1	14
Subj 3	2	0	3	0	0	0	0	0	0	3
Subj 4	2	0	12	0	1	0	1	5	4	23
Subj 9	2	0	7	0	5	0	1	10	0	23
Total		1	129	6	25	8	5	44	32	250
%		0.4%	51.6%	2.4%	10%	3.2%	2%	17.6%	12.8%	100%
Median		0	6.5	0	1	0	0	1.5	1	14.5
N	17	16	16	16	16	16	16	16	16	16

Tables 3-5 show the students' responses to interview questions about their preferred use of annotations. Table 3 shows the same preferences reflected in the response to the interview question as are seen in Table 2 which is based on marker data.

Table 3: Responses to interview question following Task 1 – write a paper. “How would you identify the key issues mentioned within the following passage of text?”

Annotations	#
Highlight	15
Underline	6
Note	2
*	1
[ ]	1

Table 4 shows students responses by group to the interview question which was intended to give students the opportunity to express interest in using the social element of the e-book.

Interestingly however, the students in the not social group mentioned using some social strategy with the same frequency as students in the social group who were explicitly given that opportunity by the social element in the e-book.

Table 4: Responses to interview question following Task 1 – write a paper – comparing the social and not social groups. *“How would you go about collecting alternative ideas and opinions about the issues you have identified?”*

Strategy	Not Social	Social
Others students; their annotations	4	3
Primary sources	1	
Online; Google; internet	1	1
EBSCO; PSYCInfo	1	2

Table 5 shows the students response to a question about how they might organize their work of writing the paper. An organizing element was not clearly part of the prototype and students responses reflected this.

Table 5: Responses to interview question following Task 1 – write a paper. *“What tools would you use to collate all your ideas together before starting to write your paper?”*

Tools	#
Word processing document	5
Outline	3
Notecards	2
Print hard copy	2
Sticky notes	1
Write summaries	1
Annotations; notes in ebook	1
Notepad (paper)	1
Copy & paste	1
Google doc	1



Table 7 and Table 8 show the responses to the interview questions which followed Task 2. In each table the pattern of response is the same as in the marker data for Task 2. The results are also very similar to those for the marker data and the interview data for Task 1.

Table 7: Responses to interview question following Task 2 – Take a quiz. *“How would you identify three elements of the following passage of text that are important for you to remember for the test?”*

Annotation	#
Highlight	12
Underline	5
Note	3
[ ]	2
Summary	1
Symbol	1

Table 8: Responses to interview question following Task 2 – take a quiz. *“Imagine that there is something that you don’t quite understand in the following passage of text. How would you indicate that there is something confusing about the text? How could you use the tools provided in the digital book to help you better understand the confusing elements of the text?”*

Annotation	#
Highlight	10 (w/ different color 2)
Note	9
Symbol	7
Underline	2
Summary	2
[ ]	1

(Note: This question was included in the interview with the previous two. It did not yield meaningful responses.

*“Are you sure that you have identified the three most significant elements within the text. How could you use the tools provided in the digital book to confirm your findings?”*)

### Annotation use in Task 3

The annotation frequency data from Task 3 were collected differently from that in Task 1 or Task 2. The task instructions and the text were identical to those in Task 2 – preparing for a quiz. However, the students were asked to use a paper version of the text and to mark directly on the paper. The data were collected by observing the students making annotation on the video recorded using Morae. There was no marker data for Task 3. Task 3 was also different in that it was preceded by an interview activity that explicitly asked students to think about and choose symbolic annotations.

Table 9 shows a pattern of annotation very similar to that of Task 1 and Task 2. However, there were interesting differences as described below in Table 17. Observable in Table 9 are a greater number of uses of symbolic annotations.

Table 9: Frequency of use of various annotations on paper in Task 3– take a quiz – based on review of video of Task 3

Annotation	# of Subjects Using	Frequency of Use
highlight	14	1-2-2-3-3-4-7-10-11-15-16-16-21-27
underline	14	1-1-1-3-4-4-5-6-6-6-8-9-10-10
*	10	1-1-1-1-2-2-2-3-3-11
?	8	1-1-1-1-1-2-2-3
[ ]	7	1-1-1-1-2-2-2
( )	5	1-2-2-2-2
note	5	1-2-2-2-7
!	3	1-1-4
	3	3-3-9
+	2	1-2
X	2	1-1
i	1	1
#	1	1
O (circle)	1	4

Table 10, Table 11, and Table 12 contain the responses to interview questions following Task 3. Each shows the now familiar generic choices of annotations with more symbolic annotations.

Table 10: Responses to interview question following Task 3 – take a quiz. *“How would you identify the passages that are meaningful for you to remember?”*

Annotation	#
Highlighting	12
Underline	9
?	9
*	6
Stem arrow	1
Circle	1
[ ]	1
Notes	1
!	0
()	0
Colors	0
Symbols	0

asterisk

Table 11: Responses to interview question following Task 3 – take a quiz. *“How would you identify a passage of text that you would like to follow up on or take further action?”*

Annotation	#
?	6
hl	4
!	3
Note	2
[ ]	1
Summarize	1
+	1
#	1
X	1
	1
*	1
_____ (underline)	1

Table 12: Responses to interview question following Task 3 – take a quiz. “How would you mark the passages that require further clarification for you, knowing that you could get help from a professor or a fellow student to explain them better?”

Annotation	#
?	2
*	1
Underline	1
Circle	1
+	1
Note	1
X	0

### Analysis comparing annotations in Task 1 and Task 2

In an effort to understand more subtle patterns in the frequency of annotation so additional simple analyses were performed. Each analysis was designed to answer a particular question.

Task 1 and Task 2 were distinctly different tasks. Did these different tasks elicit different patterns of annotations? Table 13 was constructed to determine if there were differences in the distribution of frequency of annotations between Task 1 and Task 2. The shaded rows show that though the tasks were different the distribution of annotations was the same between the two tasks.

Table 13: Comparison of distributions of use of annotations between Task 1 and Task 2

	C	H	I	N	O	S	U	X	
Task 1 Write paper									Task 1 Totals
Total	1	129	6	25	8	5	44	32	250
%	.4%	51.6%	2.4%	10%	3.2%	2%	17.6%	12.8	100%
Median	0	6.5	0	1	0	0	1.5	1	14.5
Task 2 Take quiz									Task 2 Total
Total	0	81	4	14	15	5	36	12	167
%	0%	48.5	2.4%	8.4%	9%	3%	21.6	7.2%	100%
Median	0	3	0	0.5	0	0	1	0	10.5
N	16	16	16	16	16	16	16	16	16

How consistent was the students’ annotation behavior between Task 1 and Task 2? A simple assessment of consistency is the correlation coefficient for the total number of annotations for Task 1 and Task 2. Table 14 shows three types of coefficients that might be used. There is a moderate correlation between the number of annotations a student made on one task and his or

her number of annotations of the other task. Perhaps this is evidence that there are “annoters” and not “annoters” and that individual differences in account for some of the similarity in the annotation patterns between the three tasks.

Table 14: Correlation between the number of annotations made in Task 1 and the number of annotations made in Task 2.

Test	Correlation	Significance
Pearson r	.587	.021 (2-tailed)
Kendal tau_b	.394	.050 (2-tailed)
Spearman rho	.524	.045 (2-tailed)

The data in Table 15 is an answer searching for a question. Table 15 shows the median number of annotations made for Task 1 and Task 2 for the social group and for the not social group. Recalling that the students were randomly assigned to the groups the only other obvious difference is that the social group experienced the social version of the iPad prototype for each task. Table 15 shows that the median number of annotations between Task 1 and task 2 differs significantly for the social group – Task 1 median = 17 and Task 2 Median = 11. The medians for the not social group are essentially equal at 10 and 11.5. Is there a useful explanation of this observation?

Table 15: Comparison of differences in use of annotations between the Social group and the Not Social group on the two tasks.

Social vs Not Social		Task 1 Annotations	Task 2 Annotations
Social			
	Median	17	11
	N	6	7
Not social			
	Median	11.5	10
	N	10	9
Total			
	Median	14.5	10.5
	N	16	16

Table 16 provides some potentially valuable information about how students annotation strategies differ according to the task. Does the frequency of annotations vary with the task?

Table 16 shows that it may. The shaded portion of the table shows that students made annotations over twice as frequently when preparing for the quiz as when preparing to write a paper. In preparing to write a paper the students made one annotation every 95 words. When studying for a quiz they made annotations every 45 words. This is probably due to the level of detail that the student expects to need for answering quiz questions vs writing a paper.

Table 16: Comparison of density of annotations by task taking into account the word count of the text.

	Words in Text	Median # Annotations	Words/Annotation
Task 1 Write a paper	~ 1383	14.5	95.4
Task 2 Take a quiz	~ 477	10.5	45.4

Task 3 presents a kind of experiment embedded in the task. The text and task of Task 3 was identical to that of Task 2. However, there were two differences in Task 3. Task 3 was done with a paper copy of the text and the students was asked to make his or her annotations on the paper. Also, just prior to completing Task 3 the student was engaged in three interview activities which asked him or her to think about using symbols as annotations. These interview activities are described in more detail in Section 2. How might these two differences affects the data from Task 3? Table 17 shows the differences between Task 2 and Task 3. To construct this table data from Task 3 (presented in Table 9) had to be categorized using the marker categories used in Task 2.

Two pronounced differences appear in Table 17. First, the shaded cells in the Total column shows that the total number of annotations is substantially larger in Task 3. Perhaps this reflects greater level of comfort in using a familiar pen and paper interface. Second, the students used a much greater proportion of symbols as annotations in Task 3. This may reflect the salience of symbols due to the proximity of the interview activities about symbolic annotations. Apparently, at least in the short term, the students' annotation behaviors are relatively easily influenced

Table 17: Comparison of annotation frequency when using the iPad in Task 2 vs using paper in Task 3 doing the same task – preparing to take a quiz.

Source	C	H	I	N	O	S	U	X	Total
from iPad	0	81	4	14	15	5	36	12	167
from paper	0	138	0	14	0	0	74	90	316
% from iPad	0	48.50	2.40	8.38	8.98	3.00	21.56	7.19	100
% from paper	0	43.67	0	4.43	0	0	23.42	28.48	100

## Section 2: Conceptual understanding of annotation naming and selection

This section contains the results of three interview activities which asked students to identify preferred symbols and names for annotations.

The first interview activity asked the student was shown an array of symbols which might be used as annotations. The student was asked to choose six symbols which he or she thought would be useful annotations for them. The student was also asked to describe the purpose for which each of the six symbols might be used. The data for this activity was taken from the Morae audio and video recording of the student making his or her selections from the array. Table 18 shows the choices made by the students.

Table 18: Frequency of choices of symbols chosen when asked to choose 6 preferred symbols from an array of symbols.

Annotation Chosen	Frequency	Comments on use of annotation
?	14	Don't understand (5), need information – explain, need review, confusing, need clarify
*	14	important (5), as bullet, professor emphasis, interesting, come back to
!	13	emphasis, importance (4), draw attention, agreement, excited
( )	11	draw attention, more information needed, important, refer to words or phrases, locate a note
→	10	point to large sections, draw attention, very important, draw attention to something else,
[ ]	8	not sure about something, draw attention, important, mark sentence, summary, select paragraph
+	5	“no reason,” add an idea, need more information, bullet, add to note,
X	4	not relevant, not clear, don't like it
{ }	3	“fun to draw”
>	3	something greater than something else, like [ ], same as
(go, forward arrow)	3	important vocabulary
#	3	testable, important people
(Return arrow)	2	
~	1	
O	1	circle
•	1	bullet

The second interview activity asked the student to think of six names that the student might use to describe the annotation he or she might use. In addition to naming the annotation the student was asked to classify the annotation as being “objective” or “subjective” according to criteria given by the interviewer. The data for these tables are derived from the paper forms the students used to indicate their answers. Table 19 and Table 20 show the names of annotations produced by the students and the category to which the students assigned the names. The results indicate that students do not have a readily available vocabulary with which to describe that annotation they might make.

Table 19: Names of annotations produced in free recall exercise which were considered to be “subjective.”

Annotation Names “Subjective”	Frequency of Mention
Comments	5
My Notes	3
Opinion	3
Interpretation	3
Question	2
Reflection	2
Discussion	2
Notes	1
My opinion	1
Experiences	1
Assertions	1
Observation	1
Cross-reference	1
Teacher	1
Agree-Disagree	1
Main points	1
Semantics	1
Connection	1
Thoughts	1
Personal Thoughts	1
Self-defined	1

Table 20: Names of annotations produced in free recall exercise which were considered to be “objective.”

Annotation Names “Objective”	Frequency of Mention
Notes	10
Summary	10
Clarification	2
Important?	1
Other texts	1
“Voc” ?	1
Quotes	1
Comments	1
Outside info	1
Theories & objection	1
Opinions	1
Consideration	1
Interpretation	1
Symbol	1
Tab	1

In the third interview activity the students were asked to examine a list of names of annotations. From they list they were asked to choose all the ones that they might use. For each choice they were asked to classify it as “objective” or “subjective” using the same criteria as in the previous activity. They were also asked to choose two favorite annotations in each of the “objective” and “subjective” categories. The data for Table 21 is derived form the form on which the students indicated their selections. Table 21 shows the frequency of the students’ choices from the list

Table 21: Frequency of names of annotations chosen from list of possible names.

Annotation	Frequency Chosen	Frequency Preferred	Considered Objective	Considered Subjective
Notes	12	4	7	5
Summary	11	4	11	
Comment	10	5		10
Clarification	10	2	4	6
Observations	8	2	3	5
My notes	8	4	2	6
Opinions	6	1		6
Criticism	6			6
Discussion	6	1	1	5
Analysis	5	2	2	3
Interpretation	4	2		4
Critique	4	1	1	3
Review	4	2	4	
Reflections	3			3
Footnotes	3	1	3	
Evaluation	3			3
Understanding	3			3
Reasoning	2		1	1
Considerations	1		1	
Impressions				
Thinking				
Appraisal				

### Section 3: Social elements

The tables in this brief section are based on data from Task 1 and Task 2 interview questions. Individually each tables does not contribute much to understanding the social element of the e-book as it was reflected in these studies. However, taken together they show ambiguity regarding the role of the social element in the prototype.

Table 22 shows the responses of students to a question intended to elicit a reference to the social elements of the e-book. Recall that the social group had a different interface in the prototype that showed the social element on each page and allowed the student to interact with it. However, students in the not social group mentioned other students as a resource for writing a paper slightly more often than did those in the social group.

Table 22: Comparison of Not Social and Social groups on answers to interview question in Task 1 – write a paper – *“How would you go about collecting alternative ideas and opinions about the issues you have identified?”*

Strategy	Not Social	Social
Others students	4	3
Primary sources	1	
Online; Google; internet	1	1
EBSCO; PSYCInfo	1	2

In contrast to the data in Table 22, Table 23 shows a marked difference between the social group and the not social group in response to a question about seeking help with studying for a quiz. While none of the 10 students in the not social group mentioned getting help from other students, half of the social group mentioned it. In Table 24 the difference is more clear.

Table 23: Number of subjects who mention some social element in answering interview question for Task 2 – study for an quiz. *“Imagine that there is something that you don’t quite understand in the following passage of text. How would you indicate that there is something confusing about the text?”*

	Not Social	Social
Mention	0	4
No Mention	10	3

Table 24: Number of subjects who mention some social element in answering interview question for Task 2 – study for an quiz. *“How could you use the tools provided in the digital book to help you better understand the confusing elements of the text?”*

	Not Social	Social
Mention	3	7
No Mention	7	2