

Jackson R Fox A Survey of Electronic Note-Taking Behavior in Information and Library Science Students. A Master's Paper for the M.S. in I.S degree. November, 2005. 34 pages. Advisor: Bradley Hemminger

A survey of graduate students in the School of Information and Library Science at the University of North Carolina at Chapel Hill was conducted to evaluate the adoption of digital technology for note-taking in classrooms. Previous work has demonstrated that note-taking is an effective tool for information processing. Furthermore, digital tools could increase the utility of notes by allowing students to better organize information, retrieve information, and integrate external information sources. Results of the survey indicate that while students recognize digital notes as possessing positive attributes, adoption of digital note-taking is hampered by immature software and hardware tools.

Headings:

Note-Taking

Human-Computer Interaction

Education

A SURVEY OF ELECTRONIC NOTE-TAKING BEHAVIOR IN INFORMATION
AND LIBRARY SCIENCE STUDENTS

by
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Approved by

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Introduction

As information technology becomes increasingly commonplace in graduate education, it is important that we examine specific ways in which technology can be used to improve traditional learning techniques. In particular, the use of information technology for note-taking has been very low despite the potential advantages of digital notes to hand-written notes. Much of the work done in human-computer interaction (HCI) to support learning techniques has focused on novel interactions and interfaces. This approach, while informing the next-generation of software interfaces for education, is less useful in examining the adoption of existing technologies and supporting the needs of early-adopters and power users. Studying the tools and behaviors of these users can also help us gain a better understanding of the current interface limitations that bar further adoption of these technologies.

The literature on the theory and practice of taking class notes is extensive with regards to written notes. However, few studies have focused on digital class notes. Those studies that have focused on digital note-taking (e.g. Davis et al, Truong and Abowd, and Wirth) have largely focused on the design of novel systems to support note-taking with computers within the paradigms of collaborative work and ubiquitous computing. While interesting from a research perspective, these studies have done little to advance our understanding of the fundamental concepts of digital note-taking or of the current use of

technology to support note-taking. A more fundamental understanding of digital note-taking could contribute both to research into novel interfaces by providing a more complete understanding of the principles involved as well as the improvement of current interfaces and practices for supporting digital note-taking. Studies of this kind have been performed on digital note-taking behavior in specific settings. Lin et al investigated interfaces designed to support digital “micronotes” by identifying a model of the micronote lifecycle and then examining design goals that would support this style of note-taking. This work provides a framework that we can use to investigate digital class-notes. The most pertinent study to date was performed by Ward and Tatsukawa, who examined the properties of class notes and proposed design principles for note-taking applications based on these properties. This approach is also very informative and serves as a basis for continued development of design principles specific to supporting class-note taking. However, the focus of this study was the development of a new system to support class notes. While the system described (Ward and Tatsukawa 1965) is similar to current note-taking software, there is no discussion of current practice in this area.

The purpose of this study is to better understand the adoption and practice of digital note-taking for Library and Information Science (LIS) graduate students at the School of Information and Library Science (SILS) at the University of North Carolina at Chapel Hill. For the purpose of this study, note-taking refers will refer specifically to taking notes in class and the practice of reviewing those notes outside of class.

Understanding how LIS graduate students have adopted computing technology for note-taking and the practices that they have developed as a result can provide us with a better understanding of the patterns of adoption for digital note-taking in a field where

information management is a fundamental part of the curriculum. In addition, we can review the note-taking practices of these students within the framework of established note-taking theory to improve support for digital-note taking practice to the benefit of student learning. Finally, this information can be used to inform the design and development of systems to support digital note-taking.

DiVesta and Gray introduced the idea that note-taking has two functions: facilitating the encoding of information and the later review of that content from a student's notes (summarized in Van Meter et al 323). Encoding encapsulates the acquisition, processing, and recoding of information from an external source to create notes (Williams and Eggert 174). It is this process wherein the student reconceptualizes the class content to match their own mental models (William and Eggert 175). These notes are then reviewed in order to better understand the content they capture (Williams and Eggert 180). Research has shown positive correlations between note-taking and information recall of and test performance relating to the pertinent content (Williams and Eggert 178-184). This correlation is highest when students use a mixed method of semi-structured note-taking and review in combination with review of instructor provided materials (lecture notes, slides, etc) that compliment the content of the class and allow the student to verify and reinforce the content of their personal notes.

Within the contexts of HCI and note-taking, this study used a survey to examine the current use of technology to support note-taking amongst LIS graduate students. I examined the practices of general student note-taking and adoption of and attitudes towards the electronic notes and electronic note-taking tools. The results of this study contribute to the understanding of the principles involved in supporting digital note-

taking. Finally, this data provides guidelines that will hopefully enable the continued research of interfaces to better support digital note-taking.

Literature Review

The literature pertinent to this study is focused on note-taking as a tool for learning and supporting note-taking with digital interfaces. This section will review the literature in each in each field separately.

Note Taking

The literature on note-taking in college classes has focused in large part on note-taking studies and the predictive power of note-taking on student performance. Williams and Eggert provide a comprehensive review of the literature findings. The most common model of note-taking was devised by DiVesta and Gray and identifies note-taking as a two-step process of encoding and reviewing information (summarized in Van Meter et al 323). Suritsky and Hughes further divide the encoding process three separate skills: listening, processing, and recording (summarized in Williams & Eggert 174). These actions are essentially congruous and are hard to differentiate experimentally. Listening refers to the attention the student pays to the instructor and therefore the student's ability to capture information. Processing is the act of taking information from the instructor and "(1) understand each lecture point/idea and (2) connecting that understanding with one's existing knowledge" (Williams & Eggert 174). Recording happens when the student commits their interpretation (from processing) of the information to paper. Processing is the most crucial step in this phase of note-taking. During processing the student is

reconceptualizing the information they are hearing into terms they are familiar with. Without this process information is committed to paper without understanding and the efficacy of note-taking suffers as a result (Williams and Eggert 175, 180). This emphasizes the point made by Kiewra that note taking is not in and of itself effective, but that method mediates the overall effectiveness of note-taking (173). Encoding is followed by review, where the student revisits the information they encoded in their notes in order to reactivate the concepts that they heard and processed during the class (Williams and Eggert 179-184).

The beneficial effect of note-taking on student recall of information and their ability to do well on tests about that information is widely accepted (Williams and Eggert 178). However, conflicting results have given rise to a number of qualifications on this acceptance. Kiewra et al investigated the moderating effects of note-taking technique and found that outlining is a more effective method of note-taking than either unstructured note-taking or matrix-structured note-taking (183). Van Meter et al found that students reported goals and contextual effects as important mediating factors in their ability to take effective notes (332). The exact mechanisms that moderate the effectiveness of note-taking are not known, and more research seems to be required before a better understanding of the underlying variables is reached.

The most efficient and effective method of note-taking appears to incorporate semi-structured notes taken with the aid of partial information aids (such as visual aids and handouts) in conjunction with the review of additional class material provided by the instructor to supplement student notes (Williams and Eggert 189-192). The use of information aids provides the student with a loose structure in which to take notes while

facilitating processing of the information. In addition, these aids reduce the cognitive load of paying attention, freeing the student to concentrate on lower-level topics. Thereafter the information encoded in the student's notes is validated and expanded upon with the additional material provided by the instructor. The supplemental material not only validates and expands on the student's notes, but is able to fill-in the information that the student might have missed during the lecture.

Digital Note-Taking

Studies of note-taking in the HCI field fall into two broad categories: investigating novel interfaces for note-taking, and making note-taking more effective with interfaces. Studies that have focused on the development of novel interfaces for note-taking have looked at note-taking within specific HCI paradigms. The studies reviewed here are informative about the effectiveness of novel interfaces for supporting note-taking, but largely omit any discussion of the particular principles they are attempting to address with regards to note-taking. Davis et al developed the NotePals system that looked at note-taking in a collaborative environment. One variable investigated was screen resolution on mobile computing platforms. They found that the display resolution of contemporary mobile computing devices to be largely insufficient for capturing legible notes and that note-taking speed was greatly reduced compared to written notes (343). While many advances have been made in handheld computing technology since the publication of their work, their results indicate the need to evaluate the shortcomings of the current generation of devices and interfaces. Abowd et al developed a system using the ubiquitous computing paradigm as part of the Classroom 2000 project. They found that students felt that the

integration of technology into the classroom was a positive experience, but also noted that technological hurdles still existed.

Some studies into novel interfaces have looked at how to incorporate effective note-taking techniques into interfaces. For example, Truong and Abowd developed another collaborative interface called StuPad which enabled students to integrate lecture notes with their own notes. Identifying how technology can facilitate effective note-taking methods is an important goal in the development of new interfaces.

A principle- (or variable-) centered approach to studying digital note-taking would allow us to better understand the fundamental needs of note-taking interfaces. One study that has taken such an approach is Ward and Tatsukawa's work on interfaces for taking class notes. In their study they begin by identifying 10 properties of class notes and then address the design decisions they derived from these properties (961-964). This study serves as an excellent starting point for developing principles for the design of note-taking interfaces. While their work does not evaluate current interfaces with respect to the properties they identified, they do develop an interface using design decisions informed by those properties. Lin et al also used a variable-centered approach, though their work focused on note-taking outside the classroom. Their work focused on "micronotes," or small notes designed to serve as memory aids (687). They perform an artifact analysis of collected micronotes and from this analysis to develop a model of the micronote lifecycle and discuss how digital notes can improve upon each of these variables over hand-written notes.

Figure 1 – The lifecycle of a “micronote” (Lin et al)

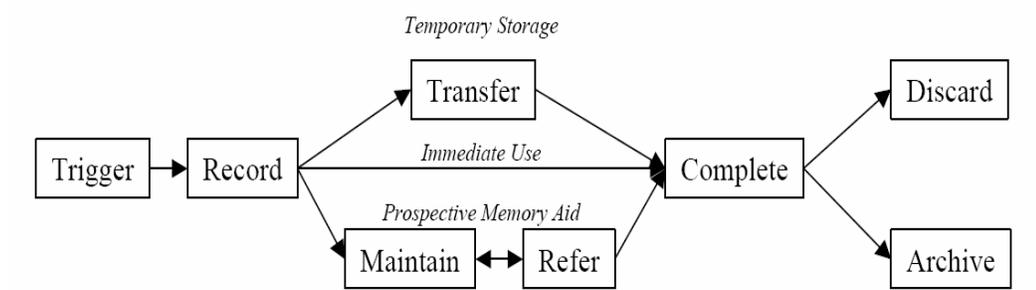


Figure 5. The micronote lifecycle model.

By identifying the specific attributes required for note-taking and developing design guidelines based on those attributes, Lin et al and Ward and Tatsukawa provide a framework for developing current interfaces as well as novel interfaces for the future.

Methodology

This study used an online survey and selected follow-up interviews to gather information about student habits relating to digital note-taking. The survey consisted of 25 items divided into six sections (Note-taking, Figures, Laptops, Electronic Notes, Handwritten Notes, General Comments). Completion of the survey took approximately 10 minutes. Survey questions focused on general attitudes toward note-taking and digital note-taking, awareness of available tools, and note-taking practices. The follow-up survey was designed to gather information about specific habits and tools used to take notes during class. However, an insufficient number of respondents were found for this portion of the study and it was not completed.

Due to the preliminary status of this survey, recruitment of participants was limited to students at the School of Information and Library Science at the University of North Carolina at Chapel Hill (SILS). This sampling frame was purposively selected to provide access to individuals who would be more likely to have access to and experience with digital note-taking tools. SILS students are required to have access to a laptop, and wireless internet access is available throughout the school. Furthermore, students within the discipline are required to have a minimal level of expertise in using computers, and are frequently exposed to advanced concepts in information technology as part of their coursework.

Participants were recruited via posts to a general-purpose student mailing list. The recruitment email (Appendix A) provided students with the address of the web survey where they were asked to consent to participate in the study before being allowed access to the survey itself (Appendix B). At the end of the survey participants were invited to participate in a follow-up interview. No compensation was provided for participation in the survey. All responses to the survey were anonymous – no information was gathered that could be used to identify study participants.

Results and Analysis

Fifty-one students completed the online survey during the four weeks it was available online.

Note-Taking

Students were first asked to approximate the frequency with which they take notes in class (Table 1). Eighty-four percent of the students who responded took notes in a majority of their classes (Table 1). Sixty-nine percent took notes in 91% or more of their classes. However, of these students only 37% took notes in an electronic format (Table 2).

Table 1 – In what percentage (%) of your classes do you take notes?

Response	Frequency	Percent	Cumulative Percent
00% – 10%	2	4%	4%
11% – 20%	1	2%	6%
21% – 30%	3	6%	12%
31% – 40%	1	2%	14%
41% – 50%	1	2%	16%
51% – 60%	0	0%	16%
61% – 70%	1	2%	18%
71% – 80%	5	10%	27%
81% – 90%	2	4%	31%
91% – 100%	35	69%	100%
Total	51	100%	

Table 2 – Do you take class notes electronically?

Response	Frequency	Percent
Yes	19	37%
No	32	63%
Total	51	100%

Furthermore, 69% of students drew figures in their notes (Table 3). Of those students, only 25% of those students used electronic tools for creating figures in their notes (Table 4).

Table 3 – Do you draw figures when you take notes?

Response	Frequency	Percent
Yes	35	69%
No	16	31%
Total	51	100%

Table 4 – Do you draw figures electronically?

Response	Frequency	Percent
Yes	9	26%
No	26	74%
Total	35	100%

While these results indicate that note-taking is a very common practice amongst students in the SILS program, only a minority of those students are using electronic tools for taking notes. Interestingly, 98% of the students who responded had access to laptops, and 94% owned their own laptops (Tables 5 and 6). Access to tools would not appear to be a limiting factor in adoption of digital note-taking.

Table 5 – Do have access to a laptop?

Response	Frequency	Percent
Yes	50	98%
No	1	2%
Total	51	100%

Table 6 – Do you own a laptop?

Response	Frequency	Percent
Yes	48	94%
No	3	6%
Total	51	100%

Note-taking literature suggests that the most efficient and effective method of note-taking incorporates semi-structured notes (such as outlining) taken with the aid of partial information aids (such as visual aids and handouts) in conjunction later review of additional class material provided by the instructor to supplement student notes (Williams and Eggert 189-192). Students were asked if they used any of these techniques in their own note-taking practices. Forty-one percent of students responded that their notes summarized information in class, and 49% responded that they summarize class information depending on the information being presented (Table 7). While only 29% of students reviewed notes frequently, only 2% never reviewed their notes (Table 8). Similarly 98% of students used material provided by their instructor either occasionally or frequently (Table 9).

Table 7 – When taking notes how much information do you usually write down?

<i>Response</i>	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative Percent</i>
Everything	5	10%	10%
I Summarize	21	41%	51%
It Depends	25	49%	100%
Total	51	100%	

Table 8 – Do you ever review your class notes?

Response	Frequency	Percent	Cumulative Percent
Frequently	15	29%	29%
Occasionally	35	69%	98%
Never	1	2%	100%
Total	51	100%	

Table 9 – Do you use materials provided by the instructor when you take notes?

Response	Frequency	Percent	Cumulative Percent
Frequently	33	65%	65%
Occasionally	17	33%	98%
Never	1	2%	100%
Total	51	100%	

Digital Note-Taking

As mentioned, 37% of students reported taking notes electronically. On average those students reported using digital notes in 63% of their classes (Table 10). The majority of those students used a laptop to take notes during class, though PDAs, Tablet PCs, and voice recorders were also used (Table 11). Microsoft Word and Microsoft OneNote were the most commonly used software tools (Table 12). Text editors (including Pico, TextWrangler, EditPlus, TextEdit, and Windows Notepad) were also commonly used. A small number of respondents (18%) used electronic tools to create diagrams. Of those, Microsoft OneNote, Microsoft Visio, and Microsoft PowerPoint were the most commonly used applications (Table 13).

Table 11 – Which of the following do you use to take notes during class?

Response	Frequency	Percent
Laptop	18	78%
PDA	2	9%
Tablet PC	1	4%
Voice Recorder	2	9%
Video Recorder	0	0
Other	0	0
Total	23	100%

Table 12 – What software do you use to take notes?

Response	Frequency	Percent
Microsoft Word	14	50%
Microsoft OneNote	5	18%
Text Editors	6	21%
OmniGraffle	1	4%
Visio	1	4%
OpenOffice	1	4%
Total	28	100%

Table 13 – What program do you use to draw figures electronically?

Response	Frequency	Percent
Microsoft Word	1	1
Microsoft OneNote	3	27
Microsoft PowerPoint	2	18
OmniGraffle	1	1
Visio	2	18
GraphViz	1	1
Palm Notepad	1	1
Total	11	100%

Of the students who took notes electronically, 68% reported that they preferred taking notes electronically over taking notes by hand (Table 14). To explore the aspects of digital note-taking that appealed to students, all respondents were asked to describe what they did and did not like about digital notes. The most commonly noted benefit of digital notes was legibility. Students noted that poor handwriting made difficult both reviewing one's own notes and sharing notes with others. The ability to edit and organize notes during and after class was the second most frequently noted benefits of digital notes. Other factors mentioned were the ability to search notes (in particular text notes), the ability to annotate instructor-provided electronic materials (such as slides and class outlines), the ability to collect and merge figures and notes from different sources, the ability to keep multiple copies of notes, and the ease of sharing with other students. A large number of students specifically mentioned that they can type faster than they can write as a reason for preferring digital notes.

Table 14 – How do you like to take notes?

Response	Frequency	Percent	Cumulative Percent
Electronically	13	68%	68%
Not Electronically	6	32%	100%
Total	1	2%	

When asked what they did not like about digital notes students mentioned the difficulty in creating figures in electronic documents, difficult-to-transport laptops, fatigue from typing, eye strain, and lack of formatting options in many software

applications. Many found laptops distracting both for themselves and others. Just as some students preferred digital notes because they could type faster than they write, several mentioned that they can write faster than they can type. Students also mentioned that digital notes lack of physicality – many reported that the act of writing itself was a form of mnemonic device.

Students were also asked to describe their ideal features for a note-taking tool. Many of these suggestions mirrored the responses given regarding negative aspects of digital note-taking. The most frequent request was the ability to input text and graphics with a pen or stylus. Students also mentioned extensive formatting options (font size, font weight, font color, highlighting, etc), common file formats to ease sharing and inclusion of outside materials, and the ability to hyperlink documents and external resources. The ideal note-taking tool was described as portable and lightweight.

Analysis

Note-taking is very common amongst the students surveyed, as are those practices generally regarded as most effective in aiding student learning: summarization of information, incorporation of instructor-provided materials, and review. However, digital note-taking is not pervasive despite the availability of laptops and other portable tools that support digital note-taking.

Amongst those students who take notes electronically, the majority prefer digital notes to hand-written notes. While some students preferred digital notes because they

were more comfortable typing than hand-writing, many based their preference on factors that are unique to digital notes. These include the ability to search notes, the ability to quickly edit and reorganize information within notes, permanence, and increased legibility. Examining the negative aspects of digital notes, it appears that tools in common use are not yet versatile enough to support the needs of students. Specifically, students suggested that drawing and text-formatting features are not yet sophisticated enough to meet their needs. Furthermore, students indicated that the physical format of common note-taking tools (laptops in particular) is a factor in their preference for hand-writing notes. The lack of tactile feedback, weight, and lack of support for hand-drawn input were all noted.

When asked to describe an ideal note-taking tool, students identified features that would overcome many of the drawbacks previously mentioned. This tool would have more sophisticated text-formatting and figure-drawing tools available, and would allow students to easily incorporate external information via embedding or hyperlinking. This tool would be lightweight and would allow pen or stylus based input for handwritten notes and figures. It should be noted that many of these features were available at the time of the survey, particularly in PDAs and Tablet PCs.

Conclusion

For any student note-taking is a fundamental technique for processing and reviewing information presented in the classroom. Past research in educational psychology has shown that effective note-taking and review can benefit both student performance and understanding of class material. Information technology holds the promise for improving upon the inherent benefits of notes by making them longer lasting, easier to manage, easier to review, and easier to share. In addition, information technology could enable new techniques that will expand upon the inherent benefits of note-taking by incorporating multimedia and other tools of digital media. However, anecdotal evidence shows us that digital note-taking is not a pervasive practice.

This study has demonstrated that while students recognized the benefits of digital notes, and despite the availability of laptops and other tools for digital note-taking, the adoption of digital note-taking amongst LIS graduate students at UNC is very low. The most likely factor is the lack of mature software tools that support the interaction methods desired by students and the lack of physical form-factors conducive to digital note-taking.

Future Research

This study is only a small piece in understanding how technology can aid in note-taking. The results of this study indicate that students recognize that digital notes have properties

that can aid in recording and reviewing information presented in the classroom. However, this recognition does not appear to be sufficient to make digital notes a compelling alternative to hand-written notes. This disparity warrants further investigation.

Specifically, would the availability of more suitable tools (as described by the students) make digital note-taking a more compelling alternative to those students who do not now take notes digitally? Furthermore, what has hampered the adoption of tools that do meet many of the requirements stated by the respondents? Both lack of pen- or stylus-based input and portability were mentioned as significant drawbacks to available note-taking tools, yet both PDAs and Tablet PCs offer handwriting recognition and are smaller (and lighter) than many common laptop models. Similarly, the lack of text-formatting options was frequently mentioned as a limitation of current note-taking applications, yet Microsoft Word was one of the most common applications utilized for note-taking. Is the lack of text-formatting truly a limitation? Or are the tools that are available not usable within the specific context of the classroom?

Another avenue of future research is into the content and organization of classroom notes. The work of Lin et al and Ward and Tatsukawa provide a good framework for this kind of study. A content-based examination of student notes would help in understanding how instructor-provided content is incorporated in to student notes, and how tools can best support the formatting and organizational features of student notes.

Because this study is focused on LIS graduate students it lacks validity with regards to the classroom at large. Similar studies using different populations would help broaden our understanding of digital note-taking and provide a point of reference when

considering the implications and application of this study. In the end, I hope that this study is the first step in building a better framework for supporting note-taking in the digital environment.

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Appendix A: Recruitment Email

I am a student from the School of Information and Library Science at University of North Carolina at Chapel Hill. I am currently doing a study to investigate the use of digital tools for note-taking in class amongst ILS graduate students. If you are interested in participating in this study, all that you have to do is complete a short 15 minute survey online about your use of laptops and other tools for taking notes.

Your participation in the study is completely voluntary and the data I collect in this study will be completely confidential. If you want to participate, go to (study URL goes here) to begin the survey. If you have any questions or concerns about this study, you may contact me or Dr. Hemminger (bmh@ils.unc.edu), who is supervising this study.

Thank you for your participation.

Jackson Fox

Appendix B: Survey

General Behavior

1. In what percentage (%) of your classes do you take notes? ____
2. Do you use materials provided by the instructor when you take notes? (Examples: slides, handouts, outlines, class notes, etc.) *Need to ask if they print these or use them electronically*
 - a. Frequently
 - b. Occasionally
 - c. Never
3. How long do you keep your notes?
 - a. 1 semester
 - b. 1 year
 - c. 1-3 years
 - d. 3+ years
4. Do you ever review the notes you take?
 - a. Frequently
 - b. Occasionally
 - c. Never
5. When taking notes, how much information do you copy down?

- a. Everything
 - b. I paraphrase
 - c. It depends
6. Do you ever edit the notes that you take?
- a. Frequently
 - b. Occasionally
 - c. Never

Figures and other graphics

7. Do you draw figures?
- a. Yes
 - b. No
8. Do you draw figures electronically?
- a. Yes
 - b. No
9. What program do you use to draw figures electronically? _____

Laptops

10. Do you own a laptop? **(If no, skip to question 14)**
- a. Yes
 - b. No
11. Do you own a CCI laptop?
- a. Yes
 - b. No
12. Do you have access to a laptop?

- a. Yes
- b. No

Electronic notes

13. Do you take notes electronically? (Examples: audio recording, video recording, typing, etc.)

- a. Yes
- b. No

14. Do you use any of the following to take notes during class? (Circle all that apply)

Hardware

- a. Laptop
- b. PDA (Palm, Pocket PC, etc)
- c. Tablet PC
- d. Voice recorder
- e. Video recorder
- f. Other, _____

15. In what percentage (%) of your classes do you take electronic notes? _____

16. What software do you use to take notes? (Circle all that apply)

- a. Microsoft Word
- b. Notepad
- c. Microsoft OneNote
- d. TextEdit
- e. EditPlus
- f. OmniGraffle

g. Other, _____

17. What format do you prefer to have your notes in?

- a. Text
- b. Audio
- c. Video
- d. Graphics
- e. Other, _____

18. How do you like taking notes?

- a. Electronically
- b. Not Electronically

Hand-written notes

19. Do you take hand-written notes?

- a. Yes
- b. No

20. Do you type up your notes?

- a. Yes
- b. No

Comments

21. What do you like about electronic notes? _____

22. What do you not like about electronic notes? _____

23. If you take notes electronically why do you? _____

24. If you don't take notes electronically why don't you? _____

25. What features would you like to see in a note-taking tool? _____

Follow-Up Interview

As part of this study, I am interested in interviewing students who use digital tools for class-note taking. This interview will last no more than one hour and can be scheduled at your convenience. If you are interested in participating, please email me at jfox@email.unc.edu.