WEB-BASED EMAIL MANAGEMENT FOR EMAIL OVERLOAD

Chatree Campiranon

Submitted to the faculty of the School of Informatics

in partial fulfillment of the requirements

for the degree

Master of Sciences

in the School of Informatics,

Indiana University

May 2005

Dedicated to my parents.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

ACKNOWLEDGEMENTS

A sincere wish of gratitude for all who have supported me through these years of study.

ABSTRACT

An email overload problem occurs when users try to utilize email service in a way it was not designed for. Moreover, many web-based email services provide large email storage space and users tend to keep more unused emails. Issues that cause email overload are 1) Keeping too many emails, 2) Using email for conversational threads, and 3) Using email as a task management tool.

Forty-five participants were selected to participate in user study sessions including questionnaire, time-on-task study, and interview. Participants were divided into three groups of 15. Participants in the first group were assigned as Gmail users. Participants in the second group were assigned as Yahoo! Mail users. After finishing user study sessions for the first two groups, the results were analyzed and the new web-based email prototype was designed as a suggestion of how the web-based email could be developed to handle the email overload problem. Then users in the third group tested the new prototype in the same manner the research was conducted with the first two groups of users.

Users in the third group were satisfied with the features and design of the new prototype. The design of the new prototype focused on solutions that are able to handle email overload problem which are 1) Email categorizing, 2) Email thread grouping, 3) Email searching, and 4) Email task management. This study illustrates how the web-based email can be designed with features to handle email overload problems while maintaining the interface usable to most users.

CHAPTER ONE: INTRODUCTION & BACKGROUND

Introduction to Subject

The use of web-based email has become mainstreaming since the user can access the inbox from any computer that is connected to the Internet. Moreover, email software is vulnerable to computer viruses. For example, worms attach themselves to an email attachment. It is safer to use web-based email, which allows the users to choose whether or not to download an attachment rather than other email client software that downloads the attachment automatically.

The amount of emails has burgeoned due to the fact that many users use mail in a wide range of activities. Although email was originally designed as a communication application, it is wildly used for additional functions that it was not designed for. For example, many users make use of email service for task management and personal archiving (Whittaker & Sidner, 1996).

There are many web-based email services such as Yahoo! Mail, Hotmail, and Gmail. These services respond to consumer demands by providing bigger storage space for free. However, it is difficult for users to manage inboxes with the large volume of emails. There is a need for a study that explores the possibility of a web-based email interface design that supports email overload.

Importance of Subject

Email usage has become overloaded because users use email service to perform a wide range of activities. Email inboxes typically contain many messages that relate to future tasks and events. These messages cannot be simply deleted since they contain important information of current and future activities (Gwizdka, 2004). The consequence of email overload can cause important email to get overlooked or

"lost" in archives (Whittaker & Sidner, 1996). As a result, the users tend to fail to access the relevant email at hand, leading to the inefficient use of decision-making time.

Based on usability evaluation on selected web-based email services, this study purposed a new web-based email prototype as an improvement to the current email interface designs. The study result will aid users to manage large amounts of email and prevent the user from wasting storage space on unused email.

Related Research

Previous studies demonstrated that email services are used for managing a wide range of tasks. For example, Mackay (1988) discussed in details how email supports a variety of time and task management activities. Whittaker and Sidner (1996) described how email overload arises and proposed technical solutions to the problem. Ducheneaut and Bellotti (2003) discussed how email turns into the central place from which work is received, managed, and delegated. Gwizdka (2004) observed two types of email users, the cleaner and the keeper, who employ distinct email task management styles.

There are a few research studies on developing email interface to solve the email overload problem. Several have focused on reminding users to manage and categorize incoming messages. Some proposed different approaches. CAFÉ (Takkinen & Shahmehri, 1998) offers three modes (busy, cool, and curious) to provide different strategies for reading, sorting, and searching messages. Rohall et al. (2001) described three information visualization techniques (trees, timelines, and low-resolution overview) in a new email client. However, there is no published research that focuses on improving web-based email interface to manage email overload. More detailed and related research is discussed in the literature review section.

Intended Project Focus

The focus of the project was to develop a new prototype of web-based email service that allows users to manage large amounts of email more efficiently. The study included a literature review, a usability evaluation of users when using selected web-based email services, which are Yahoo! Mail and Gmail. Based on these studies, the new web-based interface design was developed regarding the major issues that require support. Finally, there was an extended evaluation of the new email prototype.

CHAPTER TWO: LITERATURE REVIEW

Email Overload

This section of the literature review will be an introduction to the concept of email overload. As email becomes part of our daily lives, there are millions of email users spending a significant amount of time managing emails. Mackay (1988) started the study on the diversity of email use and stated that email provides a mechanism for supporting a variety of activities. Whittaker and Sidner (1996) defined the term "email overload" as the use of email for functions that it was not designed for. The authors stated that email applications were originally designed for asynchronous communication, but it is now being used for additional functions, such as task management and personal archiving. Gwizdka (2000) supported the idea of email overload and found that email is used for four types of information, which are prospective (future), ephemeral (current short-lived), working (current medium-span), and retrospective (past). The typology is determined based on the usefulness of information over time. They suggested that email has not been designed to easily handle prospective (mostly to-dos) and ephemeral information. Gwidzdka conducted another study that provides a model of prospective memory and weak spots in email support for prospective messages (Gwizdka, 2001).

Even though email is not designed to handle personal task management, Bellotti at al. (2004) presented that 35.8% of the number of total to-dos were recorded in the users email (other to-dos are recorded in PDA, notes, planners, online folders, etc). Their work also pointed out that people are not unskilled at prioritizing. Rather, they have well-honed strategies for tacking particular task management challenges. But the problem is the required effort from the users and the need for outlined

resources and methods to aid managing tasks. This finding leads the research on email overload to focusing on email and task management.

Email and Task Management

There are many previous studies on email and task management. This section of the literature review will be mainly used to support the understanding of the users' behavior on email and task management in order to design the improved web-based email interface.

According to Mackay's (1988) study, email contributes to at least three different kinds of work: information management, time management and task management. People who filter emails before they eventually read their messages are prioritizers. They view successful time management as performing important tasks first and ignoring unimportant tasks. Another type of email users who are interested in filtering after reading or skimming new messages are archivers. Archivers manage emails in the aspect of information management. They tend to save a large percent of their mail messages and maintain a large number of mail folders. Email is also being used for delegating tasks. Some people, such as managers and administrators, are more often requesters of tasks while some other people, such as secretaries, are more often performers of tasks. However, prioritizers, archivers, task requesters, and task performers are not mutually exclusive. For example, a person who prioritizes mail messages can also manage messages into structured directories. The research result presented that the use of email is strikingly diverse. It implies that one's own experiences with email are unlikely to provide sufficient understanding of other's uses of email. Mackay offered this suggestion regarding this issue: "Mail designers should thus seek flexible primitives that capture the important dimensions and provide flexibility for a wide range of users."

Whittaker and Sidner (1996) extended Mackay's findings by observing how the inbox is used. The results presented that there are specific types of messages that are often not discharged immediately:

- "To dos" – Messages which require the user to execute some action. Theses "to dos" are kept in the inboxes as reminders of unfinished tasks.
- "To reads" – Long documents which are often informational and do not require a reply. Users often delay reading them since they take time and effort to read. So the inbox may contain unread or partially read documents.
- "Message of indeterminate status" – Messages which users are often unsure of the significance of when it first arrives. Users will register its arrival, then delay dealing with it until some later point when they are more certain of its importance.

All three types of messages indicate incompletion. And the usual strategy is to leave them in the inbox to serve as reminders when further action is required. The authors also described three email management strategies employed by users, and divided the users into the following groups:

- No-filers – users who do not make use of folders and keep a majority of mail in the inbox.
- Spring-cleaners – users who made use of folders with the extensive folder structures, but who categorize their email periodically, about every one to three months.
- Frequent-filers – users who made an attempt to categorize or delete messages into folders daily.

No-filers and spring-cleaners have problems keeping up with task management in email, as well as with filing messages into folders. Frequent-filers encountered relatively few problems, but they had to spend more time on trimming their inboxes daily.

Balter (2000) extended Whittaker and Sidner's study by providing a keystroke-level analysis on the relationship between different organizational strategies and time spent on those strategies. The result presented that the strategies were changed according to time and number of messages received. When the user has less than 50 stored messages, receives two messages per day, and searches for one message per day, the most efficient strategy is not to use folders, and to search manually regardless of the number of folders. If the number of stored messages increases to 1000, the number of incoming to 10, and the number of message searches to four, it is still efficient to not use folders but use a search tool to retrieve messages. When the number of stored messages increases to 5000 with 40 messages to store and 4 message searches per day, the use of folder and folder-dependent search tool is necessary. This situation is typical for a "frequent filer" (Whittaker & Sidner, 1996). A frequent filer uses folders and cleans them often. If the user does not have time to handle email archiving, he or she is more or less forced to leave the new messages in the inbox and at the same time become a "spring cleaner" (Whittaker & Sidner, 1996). A spring cleaner users folders, but cleans out the messages irregularly. When the number of stored messages increases to 5500 with 40 messages to store and four message searches per day, the users may continue spending large amounts of time managing mail into folders before realizing that the strategy becomes inefficient. This situation is for a "no filer" (Whittaker & Sidner, 1996). A no filer has given up the usage of folders and cleans irregularly, which is an excellent strategy if the user can

take advantage of the search functionality. Balter suggested that the email interface should give beginners a simple interface to start with and then evolve the interface in pace with the user's development. Their conclusion for the most efficient strategy for many users would be to use no folders and use search tools that must be easy to access and use as folders.

Boardman and Sasse (2004) showed slightly different findings from Whittaker and Sidner's study. Their aim was to study how the users manage files, emails, and web bookmarks. They attempted to categorize the participants using previous strategy classifications (Whittaker & Sidner, 1996), but were only partially successful. They found that the participants in no-filer and spring-cleaner groups tend to file some new mail immediately (typically those of perceived long-term value such as e-commerce receipts), and deleted low-value spam. In other words, they employed multiple strategies – a combination of frequent filer, spring cleaner, and no-filer. From their findings, they developed two sub-groups for multiple-strategy participants. The first group is extensive filers, who try to file many messages everyday. The latter is partial filers, who file only a few (less than five) messages everyday. Besides these two sub-categories, they still included frequent filers and no-filers in their email management strategies. They provided a remarkable point on using folders in mailboxes that: "users tend to retrieve email by sorting on metadata, such as: "sender" and "date received". Therefore, there is less need to organize to facilitate folder-based browsing" Also, they mentioned that file and bookmarks are created incrementally, making them easier to organize than email, which is acquired in an uncontrolled way. Many users who would like to organize their email do not have time to do so (Whittaker & Sidner, 1996).

Dabbish, Venolia, and Cadiz (2003) studied the characteristics of an email message that make it more likely to be discarded. According to their conclusion, the following factors affected the likelihood that a message would be deleted:

- Past communications directed to the sender – If a message was not from one out of five people regular senders, this increased the probability of deleting the messages.
- Internal communications vs. External – Messages from addresses external to the company or the organization that the user works for are more likely to be deleted.
- Number of recipients – An increase in the number of recipients of a message caused a decrease in the probability of a message being retained. Because the more recipients on a message, the less likely it was to be personally directed to the user; therefore, they were more likely to delete it.
- Past communication received from the sender – Messages from one of the top five senders in the past will be more likely to be deleted. It could be that the majority of the messages received from these senders are simply non-informational replies to a conversational thread that do not need to be saved.

Dabbish, Venolia, and Cadiz mentioned two significant points concerning why these factors were most influential: “One reason might be that these factors were the elements of the message that were made most visible in the interface for the email program these participants were using. A second reason might be because these factors typify how the participants internally categorized messages.”

There has been previous research showing strategies employed as a part of task management in email. Gwizdka (2004) examined how the email users deal with messages that related to future tasks. Four kinds of strategies were found:

- Immediate processing – messages are replied to, filed, or deleted on their first reading. It is an ideal case that the inbox is cleaned immediately.
- Limiting – portion of message is focused using particular rules (e.g., by ignoring messages that are beyond one screen)
- Encoding additional information (e.g., adding flags to messages)
- Accumulation – messages are accumulated in the inbox until they are no longer needed.

Gwizdka used an online questionnaire and four cognitive tests in this study. The questionnaire was used to construct nine email habit variables, which are 1) When email is read, 2) When email interrupts other tasks, and when the user 3) Uses search in email, 4) Transfers events from email, 5) Keeps events in email, 6) Transfer to-do's from email, 7) Keep to-do's in email, 8) Uses emails as reminders, 9) Sends email self-reminders. The first three variables describe general email habits while the latter six describe email habits related to task management of pending tasks in email. Gwizdka selected four cognitive tests which may have an effect on email processing:

- Flexibility of closure - Ability to identify a visual figure or pattern embedded in a complex distracting or disguised visual pattern or array, when knowing in advance what the pattern is (McGrew, 2003). The users need to extract email messages or email messages attribute from a distracting background.
- Speed of closure - Ability to quickly identify a familiar meaningful visual object from incomplete (vague, partially obscured, disconnected) visual stimuli, without knowing in advance what the object is (McGrew, 2003). The users need to recreate the whole structure or relationship between groups of email messages from pieces of messages that they see.

- Visual memory - Ability to form and store a mental representation or image of a visual shape or configuration (typically during a brief study period), over at least a few seconds, and then recognize or recall it later (McGrew, 2003).
- Working memory - Ability to temporarily store and perform a set of cognitive operations on information that requires divided attention and the management of the limited capacity resources of short-term memory (McGrew, 2003).

The results from the study presented two types of email users, the cleaners and the keepers. The cleaners tend to transfer future task information from email and not to use mail to handle messages related to tasks, to-dos, or events. They set specific time limits to read messages. The keepers treat email as a habit and keep future tasks or events in their mailboxes. The keepers let incoming emails interrupt other activities and read messages all the time. Gwizdka also discussed about the different values of flexibility of closure and email experience. Extracting information from the variety of email messages may be more demanding on people who possess low flexibility of closure. The people in the keepers group tend to have more email experience than the cleaners group. Since those using email for a longer time may be receiving more email messages and a wide variety of message types. Thus, there is a higher probability that the keepers usually read messages more often than the cleaners and keep email messages with future tasks or events in their mailboxes.

Email Interface Design

The usability evaluation on the design of a web-based email service was conducted by Millen (1999). In this study, remote usability evaluation methods were used in the development of AT&T's Internet service. User session logs, which include keystroke level event records, were examined for the service trial users. According to their data, there are 8% of sessions in which the only action was to list (or see) the

messages and then to delete one or more of them. This suggests that the message headers alone provide sufficient information to decide whether to read the message or not. In Millen's web mail application, he provided sender's name, subject, time stamp, and file size as the presented email header. From the users' feedback after trial, the top concerns of the web mail are the need for an address book and folder capability.

However, according to Yiu et al.'s research (1997), the use of a semantic hierarchy for filing presents many problems on dealing with large volumes of data. Filing and maintenance is time consuming and cognitively intensive. Since there can be hundreds of new messages arriving each day, it is difficult to file and maintain a reasonable hierarchy that facilitates efficient retrieval. Moreover, categories can become obsolete over time, and messages in different categories may become semantically related. Therefore, the user must spend time periodically to reorganize their mail hierarchy. Yiu et al. developed the TimeStore email system that uses time of arrivals as a principle to arrange message displays. TimeStore plots information as dots on a two-dimensional graph where the x-axis displays time and the y-axis displays a list of senders' names. It also provided mailbox views, which create virtual dynamic mail folders. One message can appear in multiple views, which eliminates the problem a message appearing in one folder. The usability evaluation results are remarkable. The users like to see trends corresponding with messages from their friends and associates. A very important discovery was that users were often unable to remember exactly when a message arrived. They often had to click on succession dots in order to find the desired message.

From TimeStore concept, Jovicic (2000) developed an interface to manage large amounts of emails by selecting time as their main organization principle. The

study was based on the role of memory in email management. They determined that email messages have two “events” of quality, which are ‘autobiographical’ (personal) and ‘news events’ (informational). Their research stated that successful retrieval greatly depends on the presence of the context surrounding the event. Components of autobiographical events that have a logical mapping onto email message attributes are people, time, and activity. In most cases, these can be mapped to sender, time, and subject of a message. Time was being the primary organization principle, sender was chosen as secondary for another axis of the visualization. Their interface gives users the option to view messages at one-week and one-month levels of granularity to compensate the possible post with passage of time. However, Jovicic suggested that the list of senders might become too difficult to manage for very large inboxes.

Gwidzka (2002) also conducted a research to design space of alternative email user interfaces by describing the relationships between messages and time. The goal of his study was to design an interface that supports a wider range of tasks in email. They stated that email messages may contain multiple references of time. The two most common are message arrival time and message reference time. The arrival time is always in the past, while reference time can refer to the past, present, and future. Gwizdka expanded TimeStore concept by developing TaskView, which uses the same graphical representation. The main focus of TaskView is on the presenting of pending task information. It presents active messages, which are messages with future references containing pending tasks. The presentation is in future time, referencing pending tasks, while in TimeStore the presentation is in past time, arranged according to message arrival time. Gwizdka conducted the user study to compare TaskView and a typical email inbox (Microsoft Outlook). The task view interface performed better for issues related to pending tasks while it performed worst for those related to

subject, sender, and content. One possible modification would be to display sender and subject together in the left-hand column of task-view. Gwizdka mentioned the ongoing design and implementation of email UI prototype, where users will be able to create their own visual organization of messages on a 2D plane. This interface design is based on zoomable user interface (Pook, Lecolinet, Vaysseix, & Barillot, 2000).

Related to Gwizdka's attempt to develop an email interface that supports pending tasks, Bellotti et al. (2003) studied the design and evaluation of a task management centered email tool. Based on their study, they built Taskmaster, which is an email system entirely redesigned in support for task and project management. Bellotti et al. identified seven specific problems that participants experienced with task management in email:

1. Keeping track of lots of concurrent actions.
2. Marking things as important amongst the less important items.
3. Keeping track of thread activities and discussions.
4. Managing deadlines and reminders.
5. Collating related items and associated files and links.
6. Implementing application switching and window management.
7. Getting a task oriented overview, "at a glance", rather than scrolling around inspecting folders.

Most of the pointed problems (except five and six) were relevant to developing web-based email interface that supports email overload. They designed Taskmaster system to address the above seven problems by repositioning email as task management, providing resources to reduce the time consuming work of overloaded multitaskers. Taskmaster supports semi-automatic collections of interdependent tasks (threads of messages, links, and drafts), which they call

“thrasks”. In the thrask model, any related incoming messages such as replies or attachments are grouped. One intriguing aspect of their study is that, according to their email-as-messaging-system model, incoming and outgoing messages are viewed together. Bellotti et al. provided options for users to add or remove items to and from thrasks. They made an insightful statement in the conclusion that, “It is also a clear indication that life in the email habitat should be rethought, not in terms of messaging, but rather in terms of the various activities users are trying to accomplish through that activity.”

There are many previous research studies on the visualization of conversation. Previous studies were focused on representing conversations in chat or instant messaging programs. However, Venolia and Neustaedter (2003) presented a mixed-model visualization that simultaneously presents sequence and reply relationships among the messages of a conversation, making both visible at a glance. They suggested plausible benefits may result from viewing messages as conversations:

- Displaying a message along with all the related messages provides better local context.
- More items can be shown at the same time to provide greater global context.
- Conversation operation can be provided. For example, provide group operation to handle conversational messages (i.e., delete, read, etc.).

As they cited in [14], thread is “a stream of conversation in which successive contributions continue a topic”. Email supports conversational trees at its core: each message includes a reference to the one it’s a reply to. Venolia and Neustaedter provided two models of conversation, which are simple sequence of turns model and branching tree model. Both models are valid and useful. They designed a mixed model conversation visualization that fully supports both the sequential and tree

models. They listed grouped messages in a chronological, vertical list because it would require scrolling in one-dimension only. Messages were listed from old (top) to new (bottom) so they could be read like a script. Venolia and Neustaedter used indent and line to identify that a message is a reply of the above message. They provided a schematic overview of the conversation tree structure which does not contain message bodies. There are at two suggestions from Venolia and Neustaedter on how they would like to improve the model. First, it should be more compact, since when a conversation consists of a sequence of brief messages, the actual message content is small compared with surrounding graphics. Second, the visualization is overkill for simple conversation since, as they cited at [8], the majority of conversations are one or two messages long.

Kerr and Wilcox (2004) presented the design of "Remail" which tackled three key problems that email researchers mentioned above discovered, which are:

- Lack of context – Early messages in a conversational thread can quickly get lost or filed away.
- Co-opting of email – The use of email for what it wasn't designed for (email overload).
- Keeping track of too many things – The failure of filing schemes when email popularity continues to grow.

Kerr and Wilcox solution was to provide people with multiple, integrated ways to organize and act on their emails. The Remail interface consists of a Calendar and two other tabbed areas. The first tabbed area consists of lists of messages in different view, such as inbox, collection, or thread. The second tabbed area consists of tabs of favorite, buddy, source, etc. They use separator to solve the problem as lack of context. Rather than providing only basic information on sender, subject, date, Remail

chunks the date information into days with date separators that make it easier to see messages from a given day as a group. There is a concept of “pivoting”, which retains the selected message to remain focused while users change the sort order. Kerr and Wilcox developed Thread Arcs visualization to show the chronology and relationship between email messages in a thread. They constructed marking email method to solve email overload problem. The messages will be marked by the user and the system. The marks consist of To-Do, Reminder, Appointment, Annotation, Alert, Collections, Live Name, Thread, Source, and Attachments. For the issue on keeping track of too many things, they provided selective display concept that the clutter of the inbox list should be reduced without hiding messages that have been designated as important. A collection is designed to be a container of pointers to email. This design responds to the finding from many of the studies mentioned above such as the number of limitations with the use of folders. With collection, one message can be represented in more than one category, while users can see the entire message in the inbox. From their usability testing results, they designed a successful solution that met the goal given. The design of Thread Arcs proved to be a powerful visualization.

Discussion and Conclusion

As mentioned in many of research studies, email overload problem occurs because users use email in the way it was not designed for. Email was originally designed for asynchronous communication tool, but now it becomes a task management tool, for example. The findings on email and task management reveals there are many strategies to manage mailbox effectively and efficiently. The most significant finding is that filing or using folders to mange emails has a number of limitations. Many studies purposed pointers to messages instead of using folders. Some studies mentioned that no-folder strategy can work very well with good search strategy. Another significant finding is to group messages in the same conversational thread together. Semi-automatic categorization is a good choice to help users categorize emails, when they can create their own category while the system generate basic category such as sender, threads, etc. Many of the interface design studies were developed for desktop applications, where they can integrate everything they designed into the interface easily. However this study is focusing on web-based email, the design has to support the limitation posted by HTML coding scheme and web browser navigation. Other ideas of visualization should have been applied, for example, different color can represent the level of depth in the conversational thread and can also represent the volume of emails in each category. The research method used in this study focused on the areas that existing literature failed to cover, such as the usability evaluation on existing web-based email service.

Research Question

An email overload problem occurs when users try to utilize email service in the way it was not designed for. Moreover, web-based email services such as Gmail, Yahoo! Mail, and Hotmail tend to provide large email storage space (250MB – 1GB). The assumption is that more storage capacity encourages the user to keep more unused emails. If it is true, users are more likely to keep more emails, it is essential to study how the email interface supports users to manage and locate email messages.

Hypotheses for Phase 1:

H1: Categorization using views allows users to manage email more efficiently than categorization using folders.

H2: Grouping together emails in the same conversational threads allows users to locate emails in the same conversational thread faster than not grouping them together.

Hypotheses for Phase 3:

H3: The interface of the new prototype encourages users to use the search function more than the search function in the interface of Gmail and Yahoo! Mail.

H4: The note feature of the new prototype is more suitable to support users' need for email task management than the calendar feature.

According to the literature review, Yiu et al. (1997) suggested the categorization using view as an alternative to folder because view provides more flexibility to email categorization. Previous researches (Bellotti et al. (2003), Venolia and Neustaedter (2003), and Kerr and Wilcox (2004)) applied the thread grouping approach as an effective way to manage thread. The design ideas of search function and note feature were based on prior usability design experiences.

CHAPTER THREE: METHODOLOGY

Participants

The participants in this study were selected as average web-based email users. There were 15 participants for each of the chosen email services which were Gmail and Yahoo! Mail. Another group of 15 participants was selected to evaluate the new email prototype. Each participant was assigned to evaluated only one product in order to avoid familiarity effect on the time-on-task study. The total amount of participants in this study was 45 persons. The entire population of web-based email users in general is diverse, in terms of experience, age, amount of usage, or even culture. In this study, all of the participants were Indiana University–Purdue University Indianapolis (IUPUI) undergraduate students and graduate students. According to the IUPUI Web site, there are over 29,000 students attending IUPUI representing 49 states and 122 countries. According to the 2003 figures from the Indiana University Fact Book, the IUPUI student population was comprised of 29,860 students. Participants were selected using the convenience selection approach. The researcher contacted IUPUI instructors from the School of Informatics and School of Library and Information Science for permission to select participants from the students in their classes. With this approach, participants were recruited faster than approaching participants directly without support from instructors. Participants volunteered. Participants were screened with the following criteria for at least moderate use of web-based email:

1. Is a regular computer user, which is defined in this study as
    a. Familiar with PC or MAC, including mouse, keyboard, and Graphic User Interface (GUI). Has at least one year of experience.
    b. Familiar with the Internet, including web browser. Has at least one year of experience.
    c. Has normal or corrected eyesight.
2. Is a regular web-based email user but not familiar with either Yahoo! Mail or Gmail. The user is defined in this study as:
    a. Regularly checking a web-based email at least five days per week.
    b. Regularly receiving email in a web-based email service at least one email per day.

The variable in this study was the email service, which is Yahoo! Mail, Gmail, and the new prototype. Participants were categorized in three groups, which are 1) Yahoo! Mail users 2) Gmail users and 3) New prototype users. There were 15 users for each group. Phase 1 consisted of 30 users (15 users from the Yahoo! Mail group and 15 users from the Gmail group). Phase 3 consisted of 15 users from the new prototype group. Assigning participants to each of the three groups was based on the criterion of assigning each participant to a web-based email service that he she was not familiar with. Each participant completed the pre-test questionnaire (see Appendix A) to gather user profile and email experience. Participants in each group complete the time-on-task testing (see Appendixes B, C, D, E, and F for usability test scripts, record sheet, and three different task sheets for three email clients) on the web-based email service. Then there was a follow-up interview session (see Appendix G) on the experience of using the email service. Users in Phase 3 also completed the post-task

questionnaire for qualitative feedback (see Appendix H). The entire process from completing the online questionnaire to the interview session could be done in 15 to 20 minutes. More details are discussed in Procedures section.

Questionnaire Results

Online questionnaire was completed by 45 participants that were selected to participate in this study. Questionnaire results yield different aspects of participants' background. Results are consolidated into tables and summarized for significant findings in each area of focus. Table 3-1 indicates the n value and percentage, and presents the number of users' selected of the respective categories on the left hand side of the table. The percentage value of n value compares to the total value of 45 participants.

Demographic information	**Users**	
	n	**%**
Age (years)		
18-25	32	71.1
27-35	13	28.9
Gender		
Male	26	57.8
Female	19	42.2
Profession		
Undergraduate student	18	40.0
Graduate student	27	60.0

Table 3-1: Participants' Demographic Information

Table 3-1 presents participants' demographic information. There are 71.1% of users in this study are in the range of 18-25 years of age while others are in the range of 27-35 years of age. The diversity of gender is distributed almost equally (57.8% for male and 42.2% for female). The majority of participants are graduate students while others are undergraduate students.

General computer and internet experience	Users	
	N	%
Operating system		
Microsoft Windows	44	97.8
Apple Macintosh	1	2.2
Computer experience (years)		
1-3	3	6.7
4-6	7	15.6
7-9	18	40.0
More than 10	17	37.8
Internet experience (years)		
1-3	1	2.2
4-6	17	37.8
7-9	19	42.2
More than 10	8	17.8
Computer usage (hours per day)		
1-3	2	4.4
4-6	19	42.2
7-9	16	35.6
More than 10	8	17.8
Internet usage (hours per day)		
1-3	8	17.8
4-6	20	44.4
7-9	11	24.4
More than 10	6	13.3

Table 3-2: Users' General Computer and Internet Experience

Table 3-2 presents users' general computer and internet experience. Almost every participant uses Microsoft Windows. There are 77.8% of the participants have been using computer for more than seven years. There are 98.8% of the participants have been using the Internet for more than three years. There are 96.6% of the participants have used computer for more than three hours per day. There are 82.2% of the participants have used the Internet for more than three hours per day. Most of the participants use a high speed Internet connection and connect to the Internet every time they turn the computer on.

General email experience	Users	
	N	%
Email experience (years)		
1-3	5	11.1
4-6	16	35.6
7-9	21	46.7
More than 10	3	6.7
Frequency of checking email (time per day)		
1-3	22	48.9
4-6	10	22.2
7-9	4	8.9
More than 10	9	20.0
Estimated duration on accessing mailbox each time (minutes)		
1-5	32	71.1
6-10	10	22.2
11-15	3	6.7
Email client software usage		
None	34	75.6
Outlook	8	17.8
Other	3	6.6
Web-based email usage		
None	0	0.0
IU Webmail	23	51.1
Hotmail	30	66.7
Yahoo! Mail	24	53.3
Gmail	13	28.9
Other	8	17.8
Current web-based email client experience (years)		
1-3	15	33.3
4-6	23	51.1
7-9	4	8.9
More than 10	3	6.7
Area of usage on web-based email		
Personal	45	100.0
Study	23	51.1
Work	14	31.1

Table 3-3: Participants' General Email Experience

Table 3-3 presents participants' general email experience. There are 82.3% of the users have been using email in the range of four to nine years. Nearly half (48.9%) of the users usually check email only one to three times per day. There are 71.1% of the users spend one to five minutes on accessing email each time. It can be implied

that those users may not spend much time using complicated web-based email features such as a calendar. Moreover, in the interview session, many users mentioned that they do not want to spend time to manage mailboxes or delete emails. Many users (75.6%) did not use email programs such as Outlook. This reflects the nature of email usage of students in which they need to access email from anywhere. Students do not have an office desk and personal computer to use. Web-based email services are widely used among students since students can access their mailboxes from any computer in their school or at home. Most users use more than one web-based email service. Many of them use IU Webmail combined with their regular email account, which mostly is either Hotmail (66.7%) or Yahoo! Mail (53.3%). There were fewer users who used Gmail since Gmail is still in beta version and users can register for a Gmail account by invitation only. All of the users have been using web-based email for more than one year. All of the users use web-based email for personal use and some users also use web-based email for study and work.

Web-based email experience in categorizing	Users	
	n	%
Create folder(s) to categorize email		
Yes	34	75.6
No	11	24.4
Amount of folder(s) created		
0	10	22.2
1	9	20.0
2	6	13.3
3	8	17.8
4	5	11.1
5	4	8.9
6	0	0.0
7	1	2.2
10 or more	2	4.4
Criterion on categorizing email		
By people		
By type of content (i.e., shopping, pictures, etc)	30	66.7
By time (i.e., last year, last semester, etc)	16	35.6
	1	2.2
Use filter to move incoming emails to particular folders		
Yes	16	35.6
No	29	64.4
Prefer the feature that users can assign an email message into more than one category		
Yes	37	82.2
No	8	17.8

Table 3-4: Participants' Web-Based Email Experience in Categorizing

Table 3-4 presents participants' web-based email experience in categorizing. Categorizing means to assign emails into categories. The questionnaire results indicate that 75.6% of the users create folders to categorize email. Users create one to seven folders. There are two users who create more than ten folders. They explained that most of the folders are categorized by person or group. 67.7% of the users categorize email by people and 35.6% of the users categorize email by type of content. 64.4% of the users never use (or do not understand) the filter function that automatically moves new mail messages into particular folders. Most users (82.2%) prefer the feature that they can assign an email message into more than one category.

One user mentioned that sometimes it is hard to determine which category that a mail should be in. This feature is applied in Gmail as a label (instead of folder) in which users can apply more than one label into each email message. The effectiveness of labeling was tested in the time-on-task study.

Web-based email experience in Thread and reply	Users	
	n	%
Prefer the feature that group all the reply messages with the original message		
Yes	39	86.7
No	6	13.3
Remove original message when replying email		
Yes	13	31.1
No	31	68.9

Table 3-5: Participants' Web-Based Email Experience in Thread and Reply

Table 3-5 presents participants' web-based email experience in thread and reply. A large conversational thread causes problems for users to locate all the messages if the messages in the thread are not grouped together. The majority of the users (86.7%) preferred the feature that groups all the messages in the same conversational threads into a single message. This feature is applied in Gmail and the effectiveness was tested in the time-on-task study. There are 68.9% of the users did not remove the original message when replying. Most of them mentioned that the original message is important as a reference. However, when the conversation gets too long, there is a possibility that some of the original messages are being removed.

Web-based email experience in prioritizing and archiving	Users	
	n	%
Action to handle important email		
Remember (do nothing)	23	51.1
Mark flag	17	37.8
Mark as unread	9	20.0
Move to folder	3	6.7
Have unused emails in mailbox		
Yes	44	97.8
No	1	2.2
Reason of keeping unused emails		
To keep record in case of referring in the future	37	82.2
Mailbox is not full (or large storage)	36	80.0
No time to clean the mailbox	10	22.2
To keep sender's email address	1	2.2
Prefer the feature that the users can set expiring date to email messages		
Yes	19	42.2
No	26	57.8

Table 3-6: Participants' Web-Based Email Experience in Prioritizing and Archiving

Table 3-6 presents participants' web-based email experience in prioritizing and archiving. Prioritizing is the action to do with current or incoming important emails. Archiving is the action to do with important emails that are no longer used but users want to keep them as a reference. Around half (51.1%) of the users did not archive or prioritize but simply remember important emails. There are 37.8% of the users that flagged important emails. 20.0% of the users mark important messages as unread. There are 6.7% of the users move important messages into particular categories. Almost every user (97.8%) had unused emails in their mailboxes. There are 82.2% kept unused messages as records in case they need to access those email contents in the future. 80.0% kept unused emails because their mailboxes are not full and web-based email services offer large mailbox storage. 22.2% of the users did not want to spend time deleting emails. This kind of user usually goes back to delete many emails once in a while (in the range of one week to three months). 57.8% of the users did not prefer the feature that allows them to set an expiring date to email

messages. Most of them mentioned that it would be too complicated and users may forget which messages have been set for the expiring date and therefore might not be able to access the expired messages in the inbox even if they want to.

Web-based email experience in Task management	Users	
	n	%
Use any task management feature such as planner or calendar in web-based email		
Yes	18	40.0
No	27	60.0
Prefer to use advance task management feature such as calendar		
Yes	13	28.9
No	32	71.1
Prefer to use simple task management feature such as notepad		
Yes	30	66.7
No	15	33.3

Table 3-7: Participants' Web-Based Email Experience in Task Management

Table 3-7 presents participants' web-based email experience in task management. 40% of the users use the task management feature in web-based email such as a planner or calendar. However, 71.1% of the users preferred not to use complex task management features such as a calendar, but preferred to use only simple task management features such as notepad. Users were explained that the notepad feature in the questionnaire referred to a new idea in which users can write notes for any email message if they want a reminder. The note would be saved with the message in the users' mailbox.

Web-based email experience in email searching	Users	
	n	%
Use search function in web-based email		
Yes	14	31.1
No	31	68.9
Reason of not using search function		
Find messages manually	28	62.2
Search box is not obvious	23	51.1
Perform only simple email activities	15	33.3

Table 3-8: Participants' Web-Based Email Experience in Email Searching

Table 3-8 presents participants' web-based email experience in email searching. Many users (68.9%) did not use the search function in web-based email. There are 62.2% of the users who searched for messages manually. Some of them mentioned that they could always remember the location and age of messages that they wanted to find. However, the search function provided more useful features than just a message search. The search function can be used as a filter to display messages by sender's name or duration of time within the mailbox. Nearly half (51.1%) of the users did not use search because the search box is not obvious, and they do not notice it. There were three Yahoo! Mail users that never noticed that Yahoo! Mail service provided email search in the mailbox area.

Treatments

Each participant was given a selected web-based email service to complete the time-on-task testing. One selected web-based email service was the new prototype created after the evaluation of the existing web-based email services. Due to the time and budget limitations, the web-based email evaluation focused on two selected email services, which were Yahoo! Mail and Gmail. These two email services provide different inbox interfaces that should be evaluated and compared. Yahoo! Mail uses folders to categorize email while Gmail uses views to label email. Yahoo! Mail has been one of the leading web-based email services for a long time but Gmail provides new features that traditional email providers did not provide, such as grouping emails in the same conversational thread together. Hotmail is also a leading web-based email, but there were reasons that Yahoo! Mail was chosen while Hotmail was not. While Hotmail provides similar email interface, such as folder management, to Yahoo! Mail, Hotmail uses smaller font size and posts more advertisements than that of Yahoo! or Gmail. And due to its popularity, Hotmail sometimes overloads and is slow to access.

Another reason for rejecting Hotmail was that it is so popular that most people are familiar with its interface and can perform the tasks in the evaluation faster because of familiarity. These reasons could affect the evaluation results so Hotmail was not selected in this study.

Analysis of Gmail and Yahoo! Mail

The product review was the web-based email service review from the aspect of interface design from the researcher's perspective. This part of the analysis can be understood as a review of how usable the product is. Mainly, the review focused on how users interact (i.e., see, interpret, navigate) with the interface of each web-based email service. The detailed review was crucial to determine the level of effectiveness of the design. Even though the two Web sites have the same amounts of contents and menus, users' experiences when navigating through these Web sites can be different if each Web site uses different colors and placements. This step of analysis analyzed the design in ways that statistical analysis could not.

Gmail Interface Review

Gmail is a web-based email service developed by Google. Gmail is still in preview release version and is not made public at the moment. Gmail is currently offering 1,000 MB of storage for each account. Google developers modify and offer new features from time to time, but this research focuses on major features such as categorization so that the minor modifications should not affect the validity of the results. The design of Gmail is new and different from previous email services such as Yahoo! Mail and Hotmail. There are plenty of interface improvements found on the design of Gmail, which can also be found in the review of the literature of email study. For example, Gmail uses labels to categorize messages. A single message can

be labeled to more than one category. This feature eliminates the limitation of one message being stored in one folder. Gmail encourages users to search messages and not sort messages. There is no sort feature in Gmail. It can be assumed from the design of Gmail that developers want users not to worry about storage space and that there is no need to delete messages.

All Gmail interface images in this paper were captured from Gmail service (http://www.gmail.com) using the username: hcithesis. The account used in this study is generated by the researcher for the purpose of the study only, and the messages in the mailbox were not related to any person's private information. This mailbox contains a total of 104 messages, four labels (family, forward mails, friends, and travel), and two starred messages.

Gmail inbox (Figure 3-1) was the first page that users saw when they logged on to their Gmail account. The Gmail inbox, which was not customized, contained 50 messages per page. It was obvious that Gmail interface contained very few images. Images used in the Gmail inbox were the Gmail logo (on the top left corner), yellow star (to indicate starred messages), and paper clip (to indicate attachments). There were no advertisements on the inbox. The interface design implemented the use of different colors for texts and tables. The result of using fewer images was faster loading time, but it could also cause the lack of visual representation. Gmail put part of the message content along with message subject. Moreover, for labeled messages, labels were placed in front of the message subject. This design might cause confusion since there were too many pieces of information in one row, and it was difficult to read. Even the design used different colors for label, subject, and content. There was no "message size" column. Mailbox usage space information was placed at the very bottom of the page. This supports the idea that Gmail wants users not to worry about

storage size. The permission to use Gmail screenshots in this section is approved by Google on May 02, 2005.

Figure 3-1: Gmail - Inbox

Messages in the main folders (inbox, starred, sent mail, drafts, all mail, spam, and trash) of Gmail were not mutually exclusive, thus, the word “view” was used instead of “folder” for better understanding. Users could choose various actions for selected emails. Actions were provided at the top and bottom of the page. Actions consisted of “Archive,” “Report Spam,” and “More Actions.” “Archive” action put selected messages out of the inbox view, but users could still access those messages in the “All Mail” view. Archive action might cause confusion since some users did not know exactly where the messages go after clicking the Archive button. An improvement could be made by adding “Archive” view instead of “All Mail” view. “Report Spam” action put selected messages into Spam view. “More Actions” function, as shown in Figure 3-2, provided options for users to mark messages as read/unread, add/remove star, move to Trash, and apply label to selected messages.

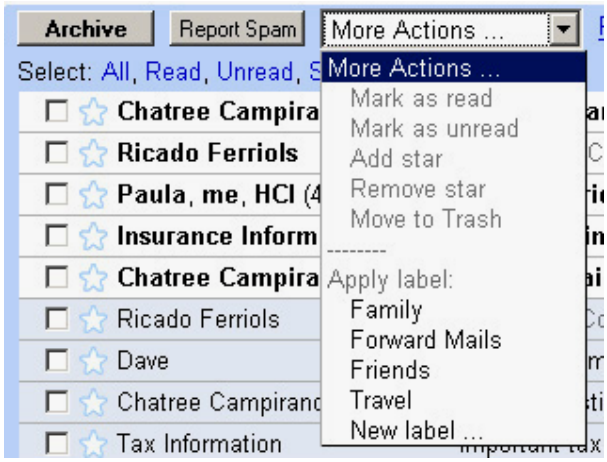

Figure 3-2: Gmail - Inbox Options

There was no column name for message list but it was obvious for users to distinguish the differences among sender’s name, message subject, and date received. Gmail provided the description of attachments and time received as caption texts (see figure 3-3, 3-4) that appear when users moved the mouse over the paper clip image or

date received text. This approach was useful in order to save the space used in the page while providing detailed information as caption texts.

Figure 3-3: Gmail - Attachments Description

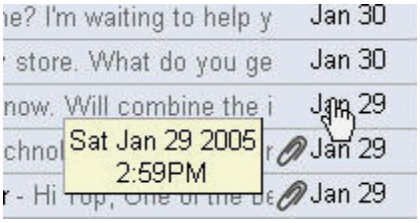

Figure 3-4: Gmail - Date and Time Received Description

Figure 3-5: Gmail - Starred Message Filter

Gmail provided a useful “Starred” view (see Figure 3-5) to filter only starred messages to show on the screen. The Star symbol indicated the same meaning as the Flag symbol in many other email services, which means, starred messages are important messages. The Star symbol, when clicked, appeared in yellow, which is a color that catched eyes attention and is the appropriate choice of color to point out important messages over all other messages. However, there should be a study on

how users interpret the meaning of the star symbol in Gmail since the star symbol is usually used in media player program for users to mark songs or movies as “favorite”.

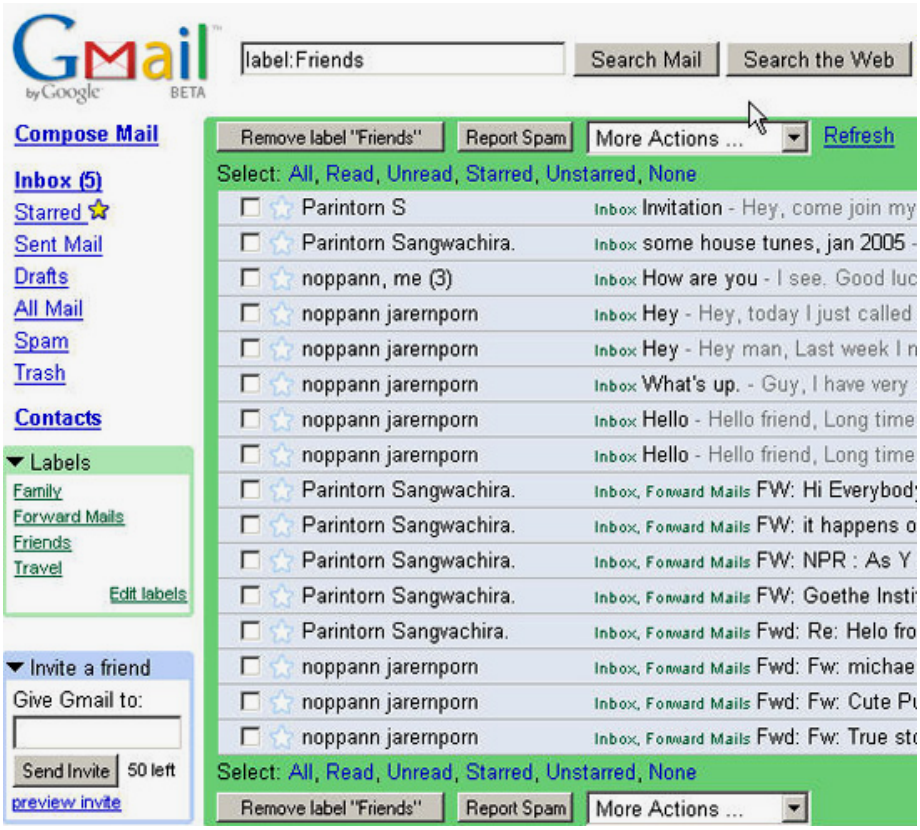

Figure 3-6: Gmail - Label View

Label, in Gmail, acted as a view for messages in inbox. Using view instead of the folder is a new idea that was suggested by many previous studies. Many other email services such as Yahoo! Mail and Hotmail use folders to categorize email. Folder structure is similar to file structure in the computer’s operating system, thus, one message can appear only in one folder at a time. Since Gmail users could apply more than one label into one message, messages with different labels were not mutually exclusive.

Label view in Gmail was shown after users clicked the label name at the left of the page. The color of message list changed from blue to green. Search box showed texts “label: Label name.” The “Remove label” button was shown instead of

"Archive" button. Figure 3-6 shows the result after clicking the "Friends" label. It might not be clear that the page is the view of "Friends" label. There should be a bigger title of label or connection between selected label and message list so that users will know which label they are currently viewing.

Google is probably the most effective search engine at this moment, and Gmail developers encourage users to use search function to search messages in their mailboxes. However, the placement of search box on the top of the page may not catch users' attention since the whole list of messages in the blue area consumes most of the screen space and catches users' eyes easily and search box can be overlooked. To promote the use of search, the search box should be placed somewhere within the same area as message list.

Gmail used green color for search result page (Figure 3-7). The use of green color is similar to label page. This indicates that Gmail used its search to filter labeled messages. Gmail applied bold fonts for search phrases that appear in the message, which is helpful for users to see search phrase within the message content.

Advanced search (Figure 3-8) was provided when users clicked the "Show search options" link. The link to advanced search should be bigger. Removal of the "Search the web" button should be considered because users might not likely use "Search the web" feature while accessing their mailboxes.

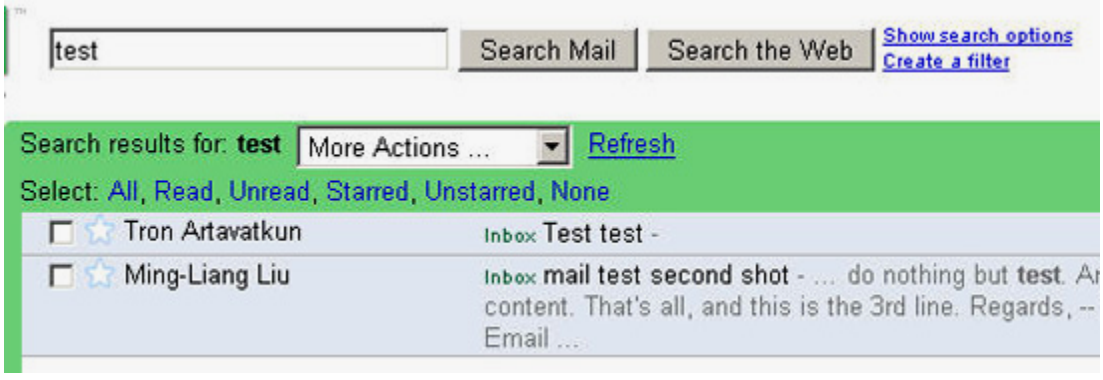

Figure 3-7: Gmail - Search Result

Figure 3-8: Gmail - Advanced Search

The Gmail message page (Figure 3-9) contained very short headers to emphasis the message content and catch users' attention. However, users might want to see more of the headers from each message. It was difficult to recognize date received since month and date were placed on the right side of the message area. All other options, such as time received, were not shown unless users clicked the "Show options" link. Gmail used gray texts for advertisement messages that were automatically attached when senders sent emails from some web-based email services, such as Yahoo! Mail and Hotmail. For some reason, Gmail also applied gray text for sender's name. On the right side of the page, Gmail posted advertisements according to the content of the message. For example, if a message was a discussion about airplane tickets, the advertisements would be related to travel agencies or online discount airplane tickets. Some people were criticized of privacy issue on this approach of Gmail. But, in fact, most of the email services have spam filter that scan incoming messages with spam detection programs. Gmail used the same approach to scan messages for advertising purposes. Theoretically, there was no user involves in message scanning process.

Users could reply or forward a message by clicking reply, reply to all, or forward, and by clicking the white text area at the bottom part of the page. When any

of those options was clicked, the white text area expanded and users could type messages into that field.

Figure 3-9: Gmail - Message Page

Conversational thread grouping, as stated in some of the previously mentioned studies, was implemented in Gmail. Conversational thread is a group of messages that relates to others by a series of reply. As mentioned in the literature review section, email supports conversational trees at its core; each message includes a reference to the one it is a reply to (Venolia & Neustaedter, 2003). Gmail grouped messages in the same conversational thread together and counts them as one message. In a normal conversational thread view in Gmail, only the most recent message was fully shown and each of other messages' information was reduced and shown as a single line presenting sender's name, part of message content, and date received (Figure 3-10). On the right side of the page, users had an "Expand all" option. When clicked, all of the messages in the conversational thread were displayed chronologically (Figure 3-11), from the first message to the most recent reply. This kind of presentation was similar to web forum where each message was posted below previous messages. Gmail's conversational thread interface reduced the time users spend on finding a

group of reply messages in mailboxes. However, there should be an option to manage conversational threads and each message that is a part of any thread. One suggestion to this design was there should be options to delete any message in a thread.

Figure 3-10: Gmail - Conversational Thread

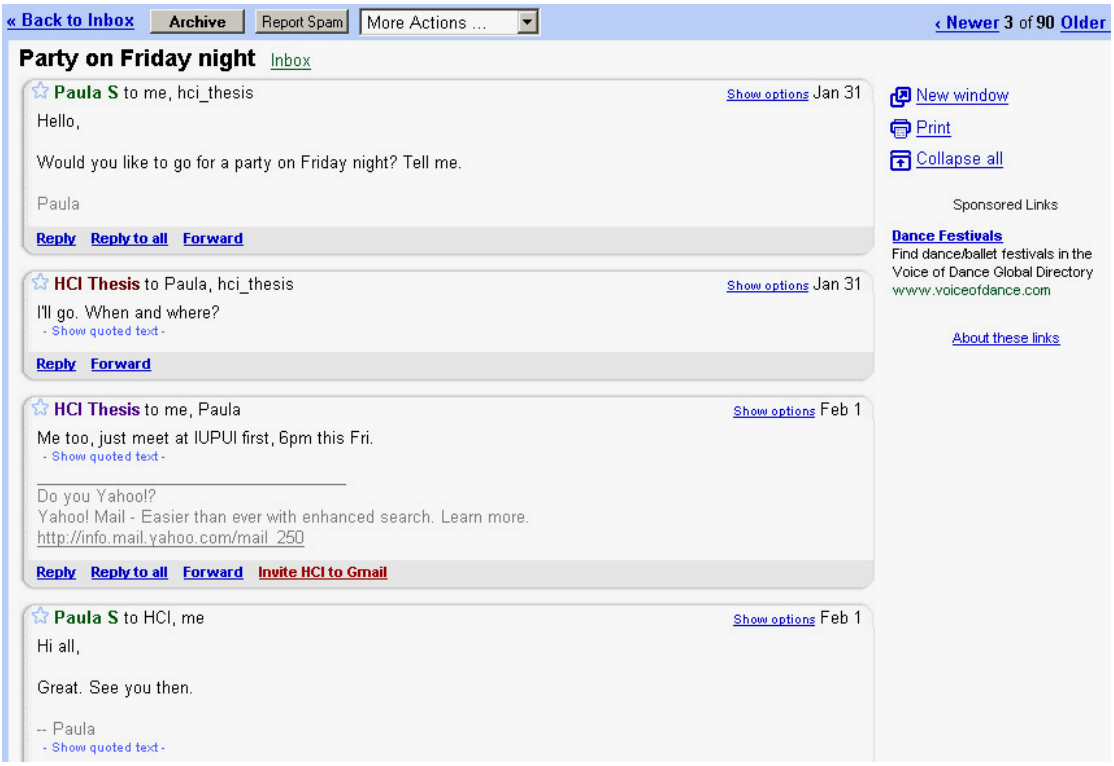

Figure 3-11: Gmail - Conversational Thread with Messages Expanded

Yahoo! Mail Interface Review

Yahoo! Mail is a web-based email service developed by Yahoo! Inc. Yahoo! Mail has been known as a leading web-based email service for a long time. There are two different versions of Yahoo! Mail which are Yahoo! Mail and Yahoo! Mail Plus. In this study, only the Yahoo! Mail version which is free is studied. Yahoo! Mail is currently offering 250 MB of storage for each account. The Yahoo! Mail interface provides all the basic functions and features that computer users can learn to use in a short period of time. Yahoo! Mail categorizes messages using folders, which is similar to the way the users organize files in their computers. More detailed Yahoo! Mail interface review is discussed in the following section.

All Yahoo! Mail interface images in this paper were captured from Yahoo! Mail service (http://mail.yahoo.com) using the username: hci_thesis. This account used in this study is generated by the researcher for the purpose of the study only, and the messages in the mailbox are not related to any person's private information. This mailbox contains a total of 104 messages, four folders (family, forward mails, friends, and travel), and two flagged messages. Advertisements were removed.

After users signed in to Yahoo! Mail, the first page shown was not an inbox. Instead the first page was Yahoo! Mail opening page (Figure 3-12) with greetings (Welcome, username), unread messages report, announcements from Yahoo! Mail, and big advertisements at the right side of the page. Besides the components mentioned, Yahoo! Mail interface had a list of folders on the left side of the page. There were blue bars at the top and bottom of the page containing the "Check mail" button, "Compose" button, and search box to search mail and search the web. To improve speed of access, this first page should be removed and users should access their inboxes after signing in.

Figure 3-12: Yahoo! Mail - First Page

As shown in Figure 3-13, Yahoo! Mail inbox could be accessed from the first page through the inbox link or “Check mail” button. If not customized, Yahoo! Mail inbox contained 25 messages per page. There was a large advertisement banner that runs at the top of the page. There were also several small advertisements placed on the left side of the page. If the advertisements images were not counted, Yahoo! Mail used only slightly more images than images used in Gmail. Lesser images used caused faster speed of access. There was a bold folder title (shown as “Inbox” in Figure 3-13) above the list of messages. At the right side of the title, Yahoo! Mail provided report of space usage of the mailbox. Two search boxes were provided, but it could be difficult for users to see since users’ attention could easily go to the list of messages and list of folders. There were four elements of messages shown in the list of messages, which were sender’s name, subject, date received, and size. Date

received information presents only day, date, and month. No year information was shown even if the year received was different from the current year.

Users could sort messages by any of the four elements by clicking the column header of the message list. There were small pictures which indicate actions and status of each message. For example, a blue arrow indicated that the message was replied to, and a green arrow indicated that the message was forwarded.

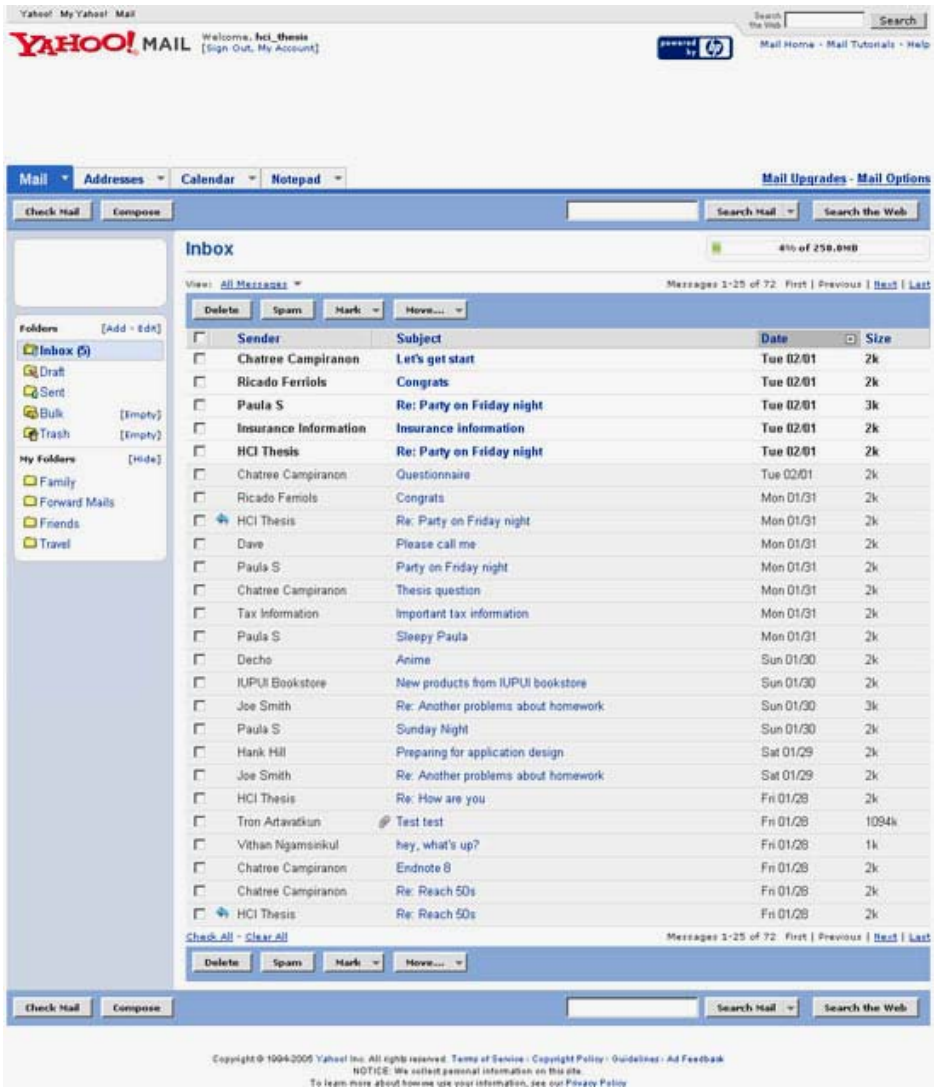

Figure 3-13: Yahoo! Mail - Inbox

There was a set of four buttons at the top and bottom of the message list. The four buttons were the delete button, the spam button, the mark button, and the move

button. Delete button sent messages into the trash folder. Spam button sent messages into the bulk folder. Mark, as shown in Figure 3-14, provided options to mark messages as unread or read, flag them for follow up, and clear a flag. The term “Mark flag for follow up” might cause confusion because some users wondered if there was a flag for any other purpose. Move, as shown in Figure 3-15, provided options to move messages to a new folder or any created folder. One message could be in only one folder at a time.

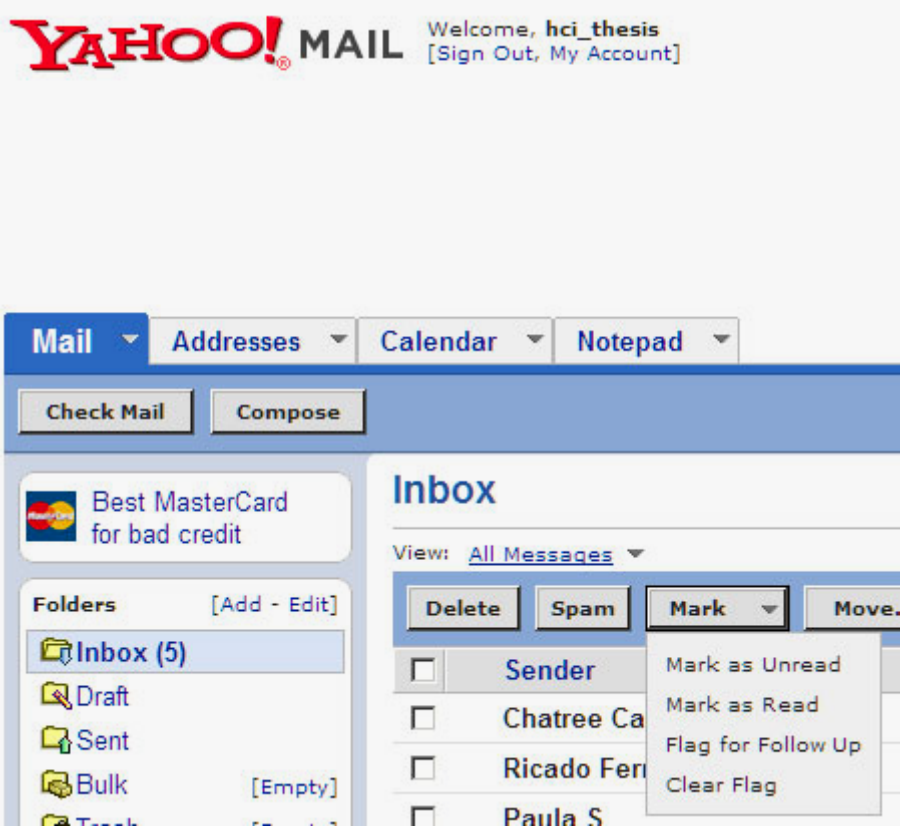

Figure 3-14: Yahoo! Mail - Mark Options

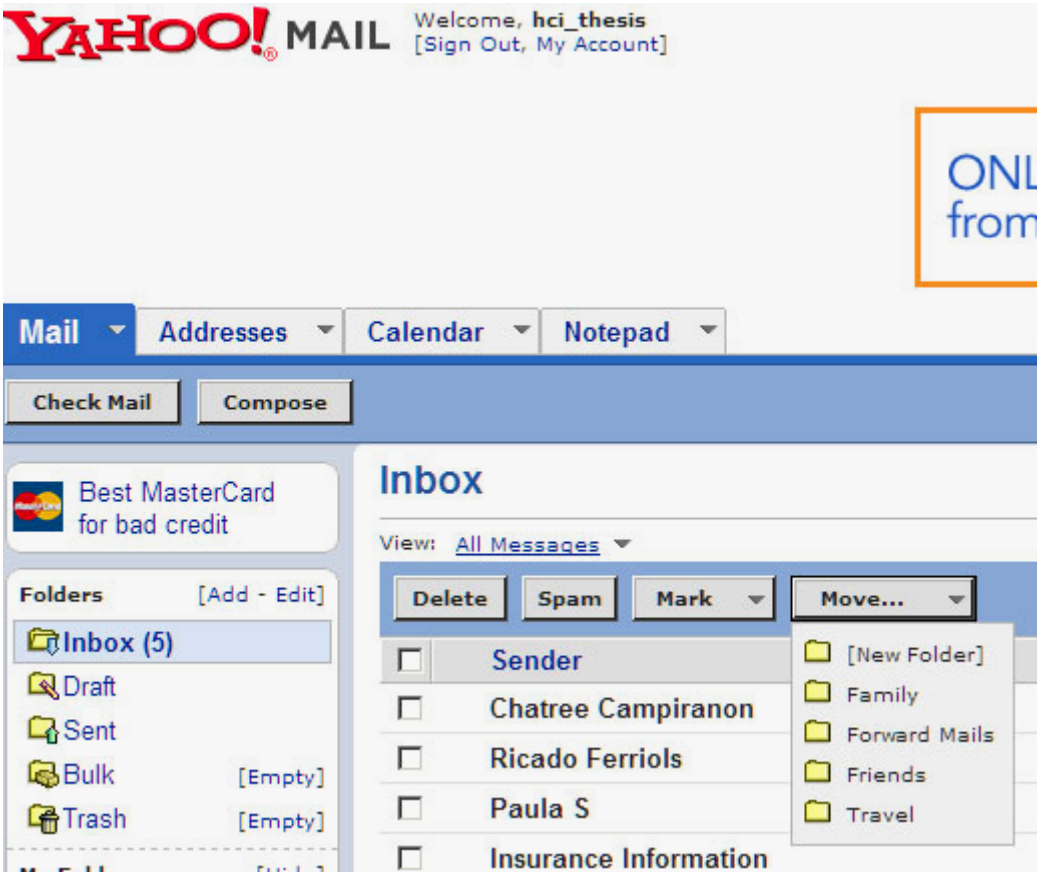

Figure 3-15: Yahoo! Mail - Move Options

Yahoo! Mail provided six view options (Figure 3-16) above the list of messages. These options were placed in a dropdown menu. The menu was made of small texts and a small triangle at the right indicates that it was a dropdown menu. The menu could be difficult to notice since there were four bigger buttons next to the view menu, which was much smaller. Some view options might not be used by many users. For example, “view messages from my contacts”, “view messages from unknown senders”, and “view message with attachments”. It is important not to provide options that users do not need because some valuable options can be harder to find among many other options. One useful view in the menu in Figure 3-16 was “view flagged messages”. This view was similar to Gmail’s starred view but the

difference was Gmail provided the view in the left side of the page along with the inbox while Yahoo! Mail placed the flagged messages view inside the dropdown menu. The result of choosing the flagged messages view was messages in the current folder were filtered for displaying flagged messages only (Figure 3-17).

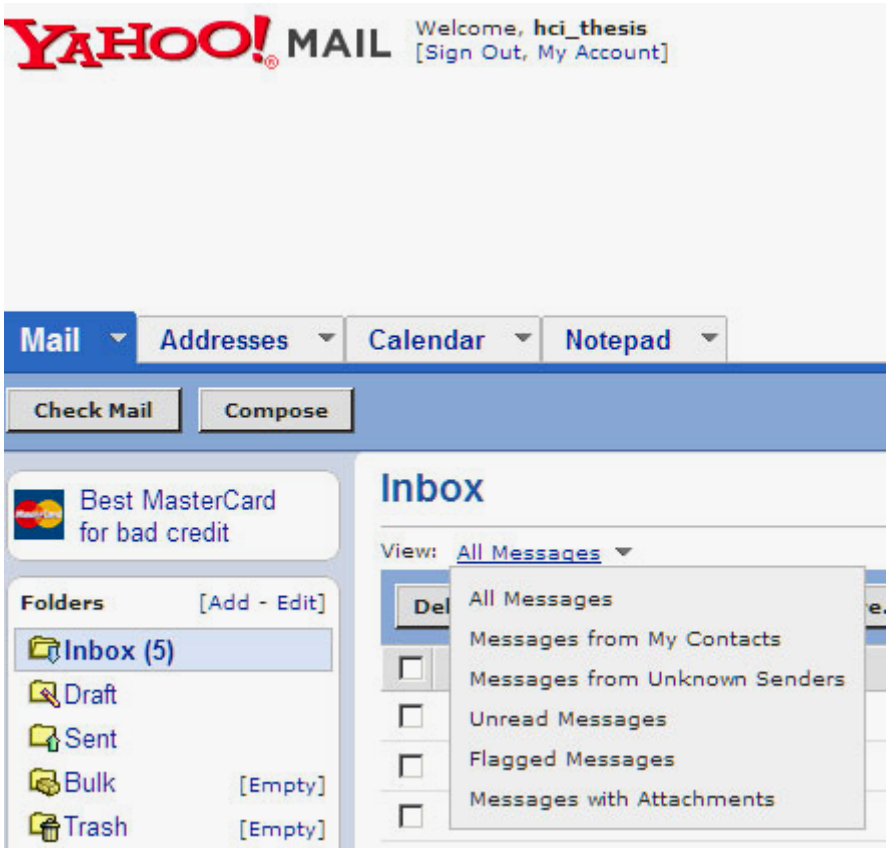

Figure 3-16: Yahoo! Mail - View Options

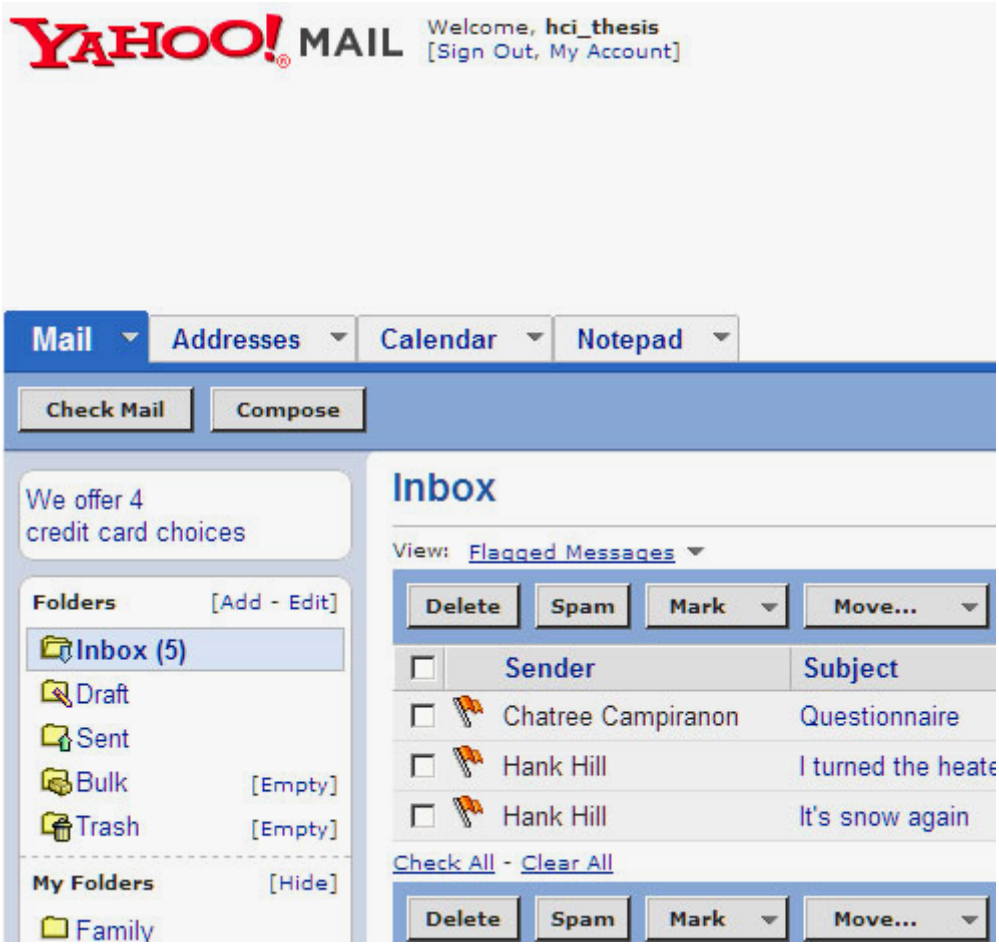

Figure 3-17: Yahoo! Mail - Flagged Messages View

As mentioned before, Yahoo! Mail used folder structure to categorize emails. Figure 3-18 shows the “Friends” folder in this mailbox. On the left hand side of the page, the “Friends” folder was highlighted and the font became bold. There was a large font title of the page, “Friends”, above the message list. This approach was appropriate since there was a consistency of usage, in that Yahoo! Mail used the title for every folder in the mailbox (including inbox, draft, sent, bulk, and trash).

Folder structure allowed one message to be in only one folder. The downside of this structure was that users had less flexibility to manage messages. The advantage of this approach was that users were familiar with this structure since this was the

same structure as folder management in offices and file management in operating systems. Folder structure was also less complicated than view (or label) structure.

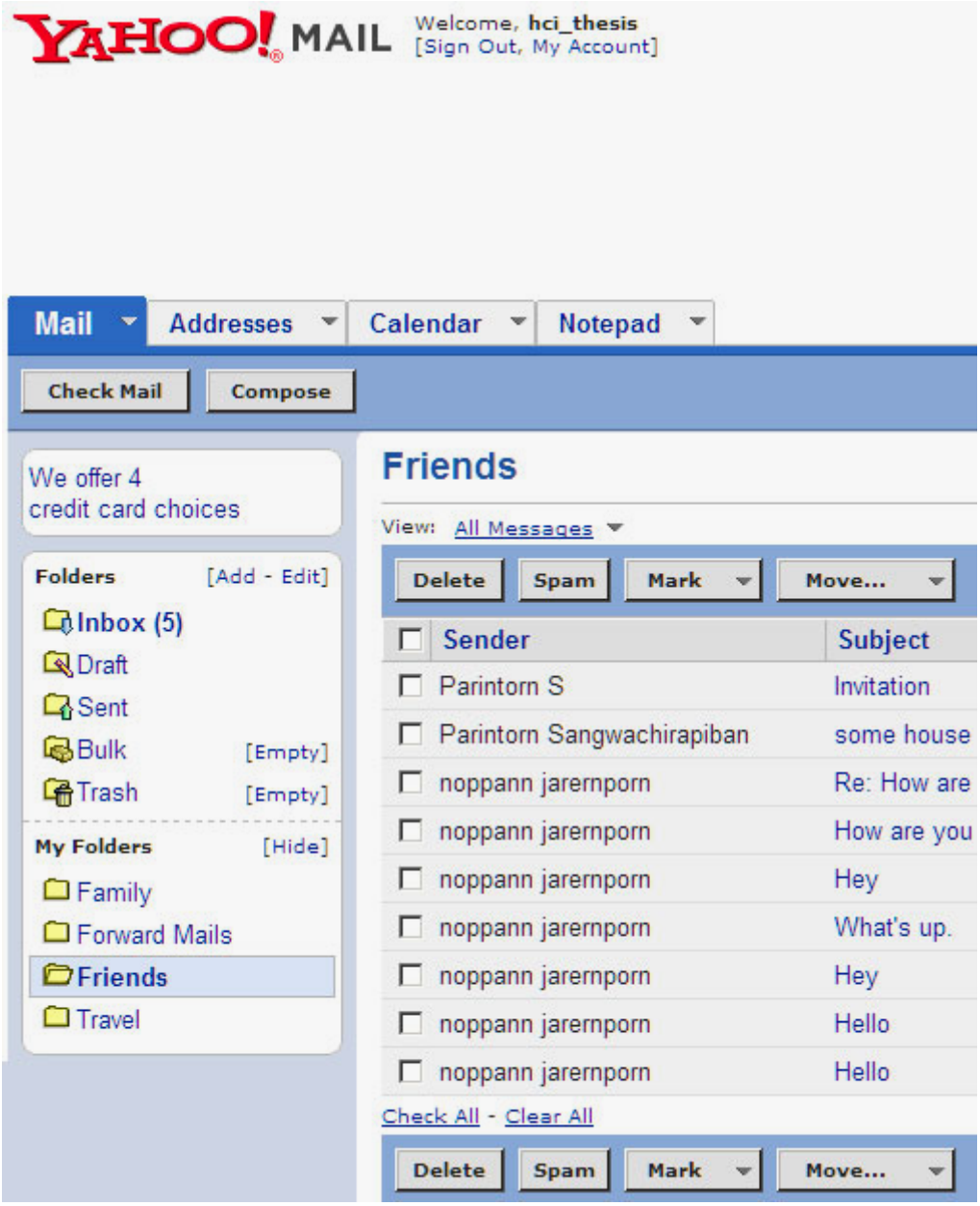

Figure 3-18: Yahoo! Mail - Folder Page

Yahoo! Mail provided search boxes at the top and bottom part of the page. The search boxes were placed far from the list of messages and it could be hard for

users to notice these search boxes. Users had options to “search mail” and “search the web.” The “Search mail” button had a small triangle sign to activate an additional option for “Advanced search.” Search results, as shown in Figure 3-19, displayed in the same interface as normal mailboxes with “Search Results” as a caption. When users used normal search, the search was conducted in the current folder only.

Advanced search, as shown in Figure 3-20, provided options to search from sender, recipient, subject, message content, and date. Moreover, users could choose to search multiple folders.

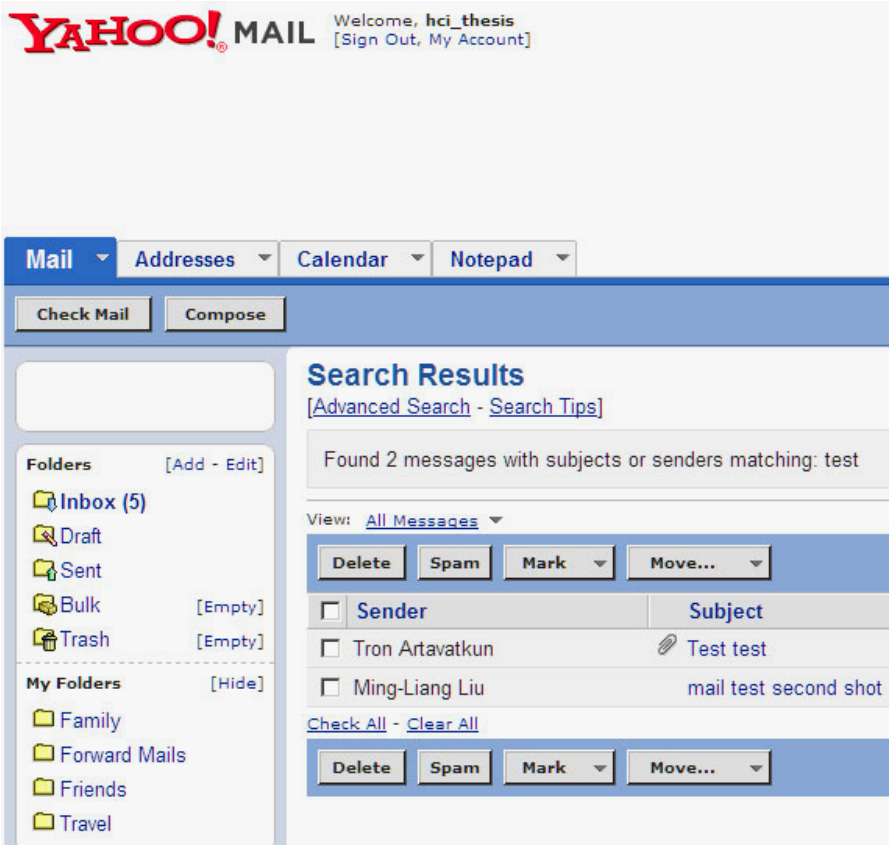

Figure 3-19: Yahoo! Mail - Search Results

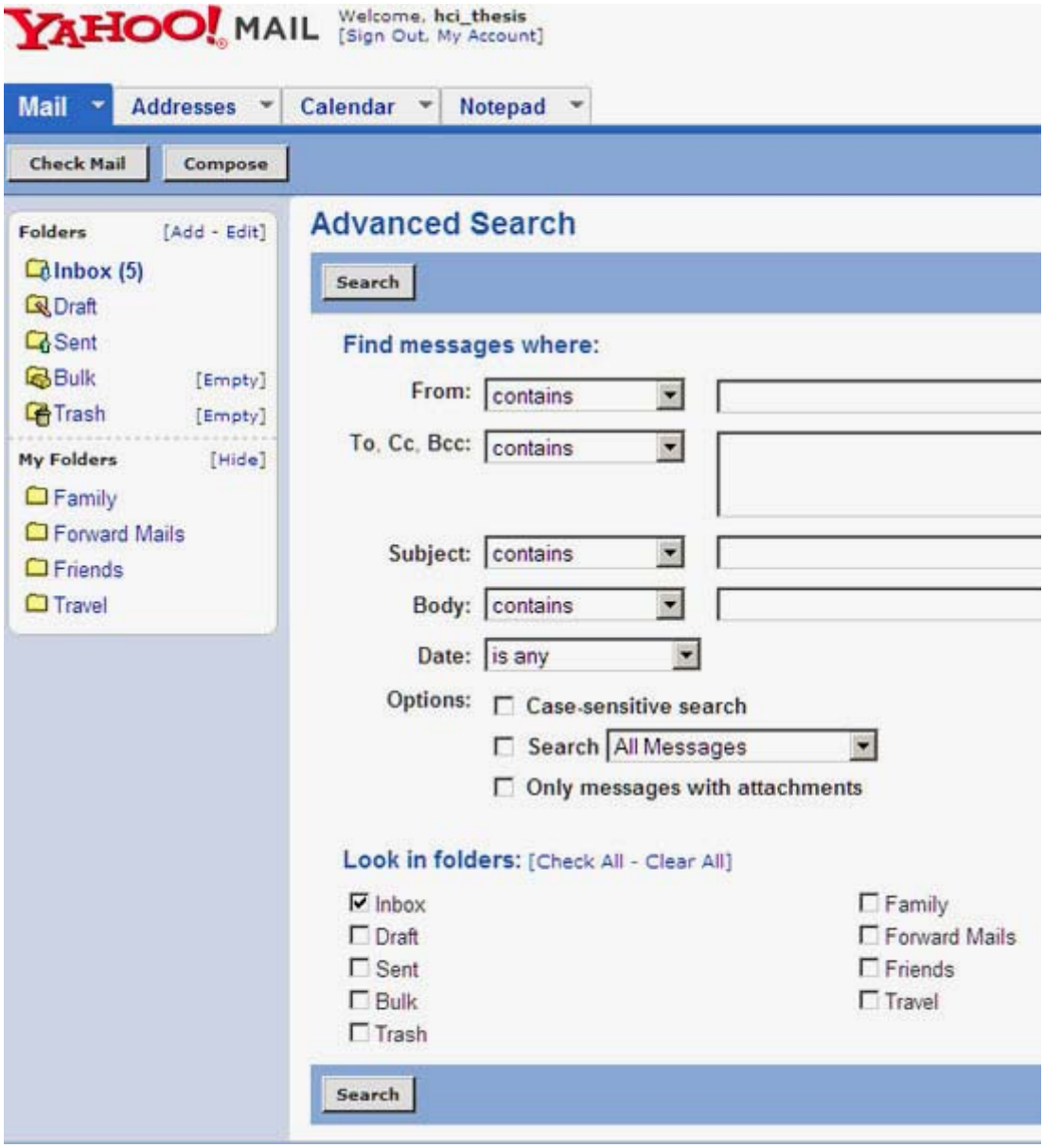

Figure 3-20: Yahoo! Mail - Advanced Search

Yahoo! Mail displayed each message with “from”, “to”, “subject”, and “date” as headers (Figure 3-21). The folder that contains the current message was highlighted with a light blue area surrounding the folder’s name. Five message options were provided including “delete,” “reply,” “forward,” “spam,” and “move.” When the move button was clicked, users had the option to move the current message into any particular folder or a new folder (Figure 3-22).

Options to mark messages for higher priority were displayed in texts links. Yahoo! Mail used the sentence “this message is not flagged” and provided options to mark flag to a message or mark it as unread. The sentence that specifies the message was not flagged might not be effective because users had to read the sentence to know the status of the message. Use of image is suggested. Flag images in different colors can describe the status of the message. A grey flag can indicate non-flagged messages, while a green or orange flag can indicate flagged messages.

Yahoo! Mail did not provide any feature to deal with conversational threads. In some web-based email interfaces, different colors are used to represent different participants in message content. However, Yahoo! Mail displayed messages in a conversational thread as normal mail (Figure 3-23). Long message texts could cause confusion when users want to find out who wrote what message and who replied to whom.

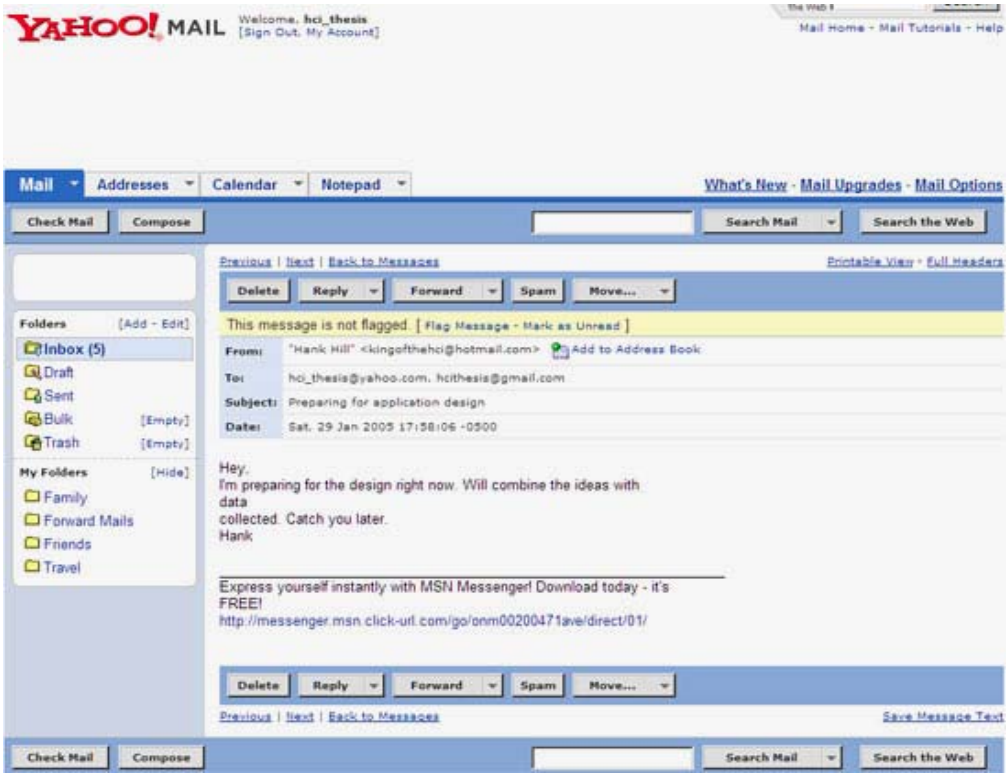

Figure 3-21: Yahoo! Mail - Message Page

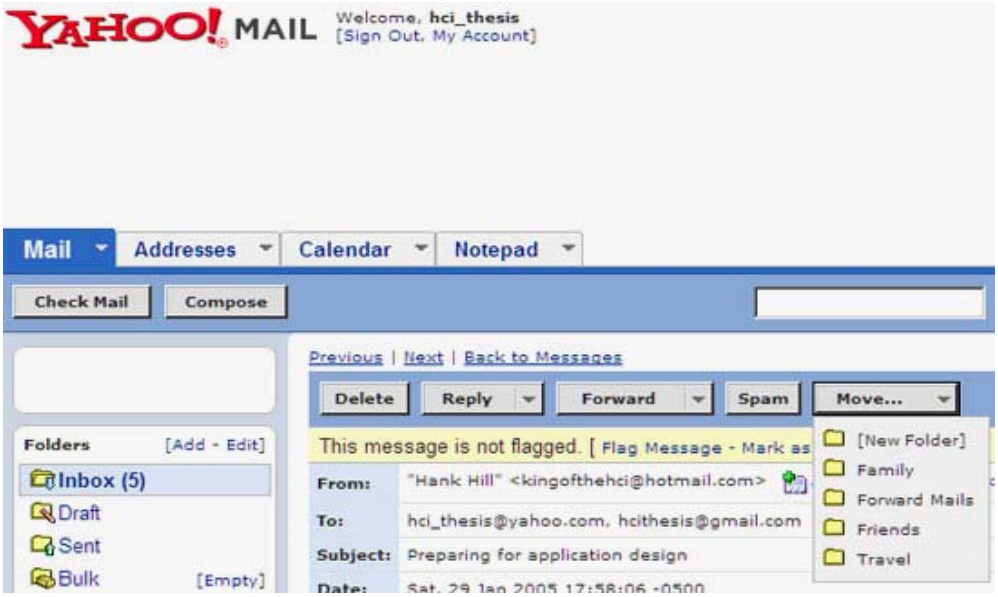

Figure 3-22: Yahoo! Mail - Message Options

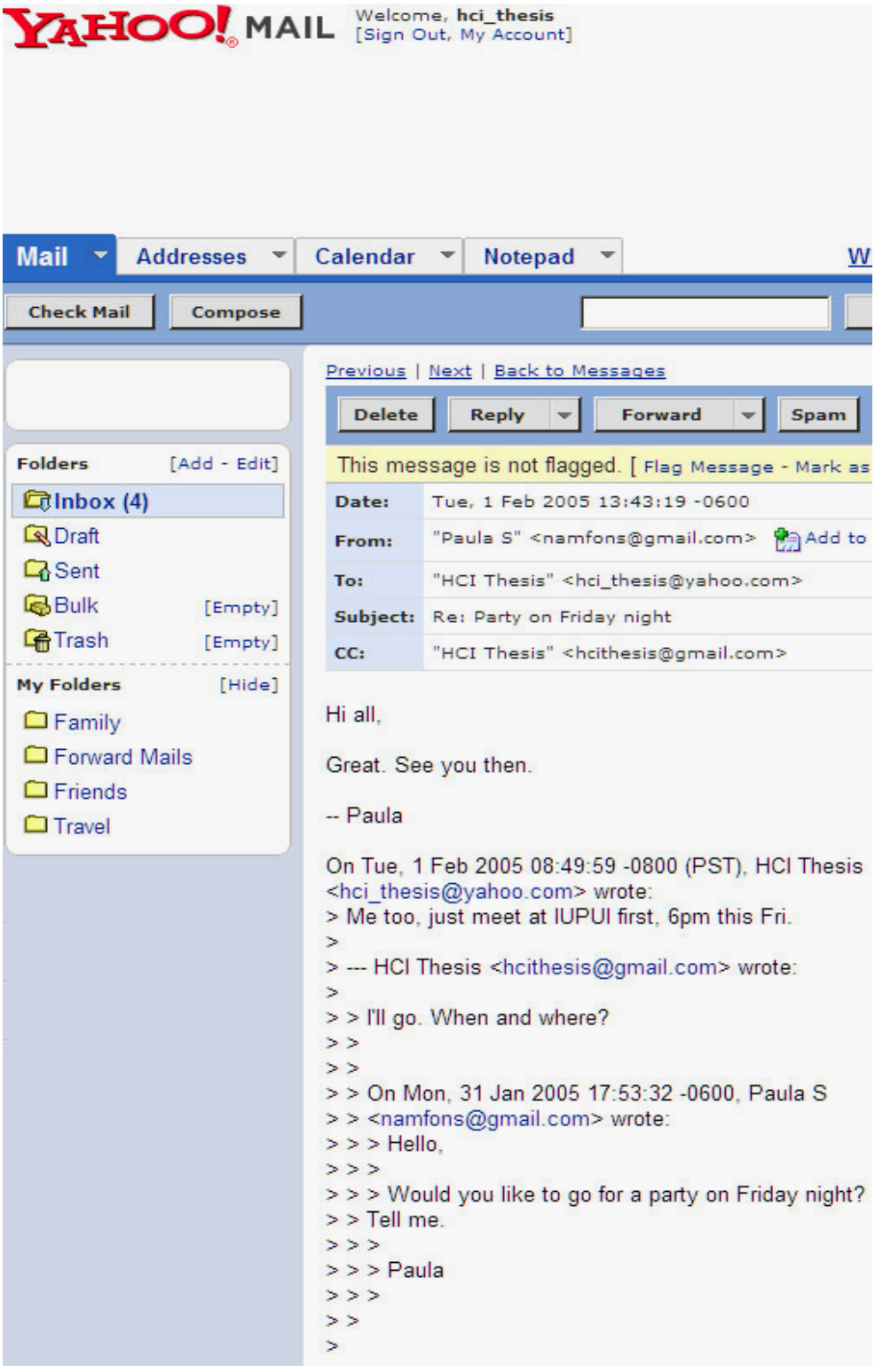

Figure 3-23: Yahoo! Mail - Conversational Thread

Gmail and Yahoo! Mail Comparison

It is clear that Gmail wants to use very few images and make more use of texts while Yahoo! Mail uses more images than Gmail. The extensive use of texts can sometimes cause frustration because users see too much information in one screen. Gmail includes a part of message content after the message subject. Gmail implements some new theories from many email studies. For example, the use of label for mail categorization and the approach to group messages in the same conversational thread. By using label, Gmail provides greater flexibility for users to label an email for more than one category. However, Yahoo! Mail uses a folder structure in which the flexibility is limited but less complicated because there can only be one message in a folder at a time. Gmail wants users to be less concerned about storage space, so that the option to delete is somewhat hard to find. Yahoo! Mail provides a delete button so that users can delete messages immediately. Gmail provides an archive folder (or archive view) for users to hold old messages that should not be deleted. An archive folder can be very useful to many users who want to keep messages as long as there is a storage space to fill. Gmail uses words that are easy to understand and close to spoken language, while Yahoo! Mail uses short words that are self-explanatory. For example, Gmail uses words like “report spam,” “compose mail,” “newer,” “older,” and “delete forever” while Yahoo! Mail uses words like “spam,” “compose,” “previous,” “next,” and “delete.” Gmail implements many new theories while Yahoo! Mail uses an interface that users have been using for a long time. Changes in the design from Gmail are constructive, but there should be consideration of whether most users are ready for those changes.

Development of the New Prototype

After the analysis of the Gmail and Yahoo! Mail user study results, the new web-based email prototype was developed as a suggestion of how web-based email could be designed to support the email overload problem. The new prototype was capable of being tested in the time-on-task testing. However, not every detail in web-based email service is covered in the design. The comprehensive explanation of the new prototype is provided in the conceptual model and prototype review section.

Conceptual Model

As investigated in the literature review section, email overload causes problems that prevent users from managing their emails effectively. Moreover, many web-based email service providers tend to provide bigger storage space. According to the questionnaire results (reported in the Participants section in chapter three), most (80% of users keep unused emails in their mailboxes because their mailboxes are not full. The following lists are aspects related to web-based email problems from email overload that the new prototype would support:

- Email categorizing
- Email searching
- Email prioritizing
- Email archiving
- Email thread grouping
- Email task management

Email categorizing: Questionnaire results indicated that 82.2% of the users prefer to be able to assign an email message to more than one category. User study results from task two (reported in chapter four) indicated that users located an email in

a label better than an email in a folder, since users could see an email in the inbox even if it was assigned to a label. Label is the idea of categorizing emails using view in which groups of emails in each view are not mutually exclusive from other emails in other views. However, the design of the new prototype suggested that the folder is still useful to separate emails that are distinctly different from others. For example, sent emails and archived emails can be separated from incoming mails. The same idea applies to spam mails and deleted mails. After separating emails into main folders, each folder has its own view to filter out a particular kind of emails in a folder, i.e., new mails, flagged mails, and emails that had been assigned into any group. A combination of folders and views would assist users in categorizing their emails efficiently.

Email searching: When there are too many emails in the mailbox, sorting is no longer effective and manual search by looking through mailboxes is very difficult. Email searching is a crucial function and the design of the new prototype encourages users to utilize the search function more than they do with existing web-based email services. The search function should search through the email sender, recipients, subject, and also message content.

Email prioritizing: The questionnaire results suggested that 37.8% of users use flag and 20% of users use the “mark as unread” feature to prioritize email messages. However, it is essential to suggest the design of the new prototype to make it easy to mark as flagged and mark as unread so that more users will use the prioritize feature for better email management.

Email archiving: Archiving is an important way to support users who wish to keep more unused emails as long as their mailboxes are not full. Having an archive category will reduce the amount of emails in the inbox and users can still keep unused

messages in the archive category in case they want to use archived emails in the future. Gmail provides an archive feature, but the category of archived emails is not distinctly separated from the inbox since archived emails have to be viewed in the "All Mail" view along with other emails in other categories. The design of the new interface includes an archive category as a folder that is exclusive from any other emails.

Email thread grouping: User study results from task three (reported in chapter four) indicate that users can quickly locate emails in the same conversational thread when those emails are grouped together. Gmail provides the grouping feature and groups emails in the same conversational thread as one conversation and present as one row in the message list. There was a problem in the time-on-task study that some users did not know that one row represented a group of email messages. Also, users could not perform an email operation such as apply a label or delete a message to an individual message in the grouped emails. The design of the new prototype includes the thread grouping feature, but each email can remain as an individual email even if it is involved in a conversational thread.

Email task management: Yahoo! Mail provides calendar and notepad features to support email task management. However, the interview results indicated that not many users normally use the task management feature in email services. Users prefer to do the task management with a physical planner or PDA because they can carry their schedule anywhere. The design of the new prototype includes a note system that handles the task management activity for each email message. Users can take a note as a reminder or for any other purpose on any email.

Prototype Review

After scoping the design with the conceptual model, the prototype was developed using HTML, JavaScript, PHP programming language, and MySQL database. Emails in the database were imported from the exact same group of emails in the tested Gmail mailbox. Emails are categorized properly as they were categorized in the tested mailboxes. The prototype is partially functional in the areas that the conceptual models focus on. Other areas where the prototype was not designed to be functional were email receiving, email composing, address book, advanced search, member system, etc. However, the prototype was functional enough to be tested in the time-on-task study without major problems.

Inbox (Figure 3-24) was the first page that users see when they logged on. The inbox contained 50 messages per page. The design contained few images. Altogether, the file size of images used in the new prototype was only 11 KB. The main images used were logo (at the top left corner), view icon (at the left side of the page), flag (to indicate flagged messages), note (to indicate noted messages), and paper clip (to indicate attachments).

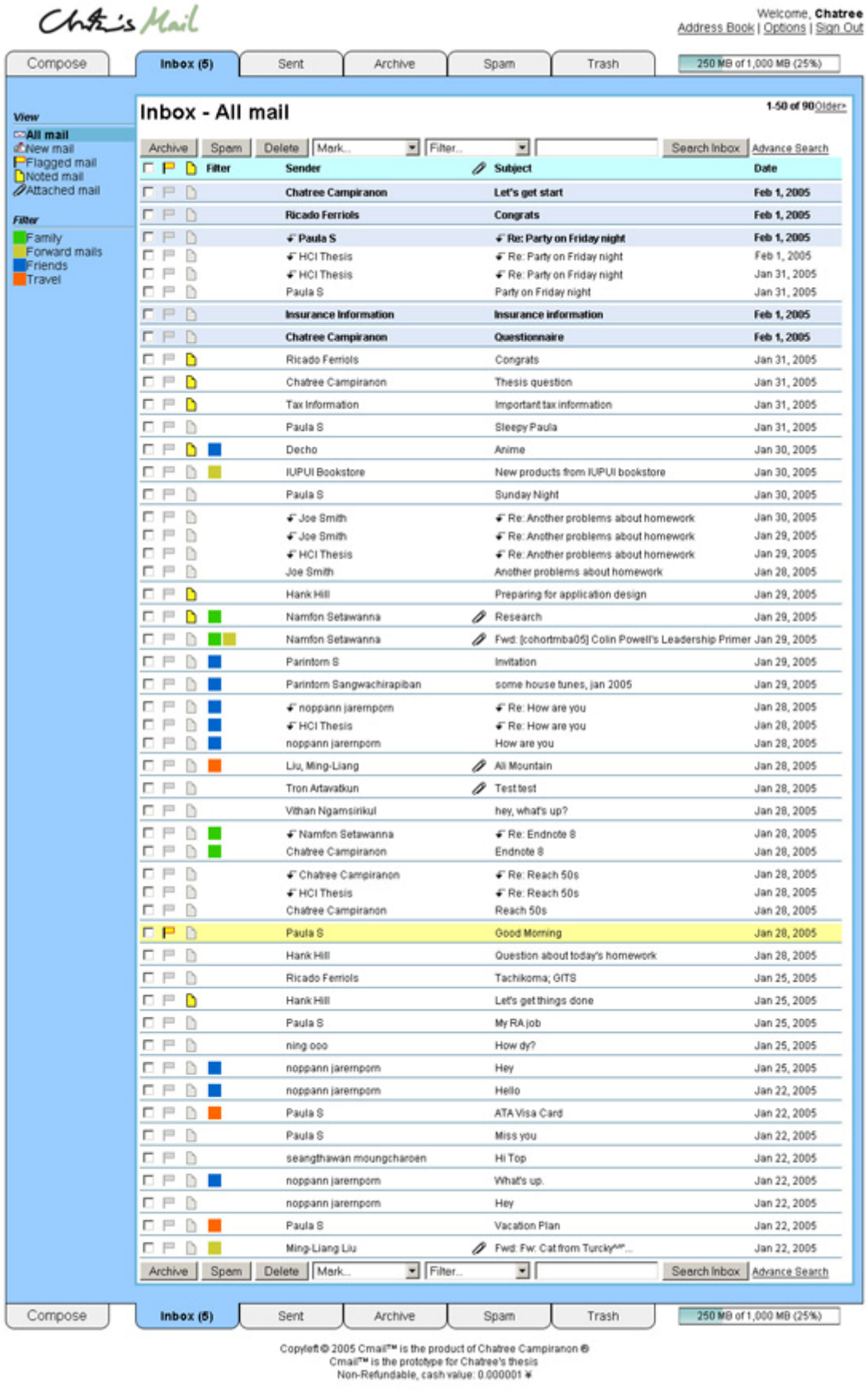

Figure 3-24: New Prototype – Inbox

The main design of the interface divided the mailbox into five mail folders, which were Inbox, Sent, Archive, Spam, and Trash. Each folder had its own views to enable users to view particular groups or types of messages. For example, Inbox folder had a “New mail” view (Figure 3-25) to view only unread messages in the Inbox and a “Flagged mail” view (Figure 3-26) to view only messages that had been marked with a flag. All the views were provided automatically by the email system; users did not have to create those views themselves. All the views provided were considered suitable to filter only a particular type of message that sometimes users want to group together.

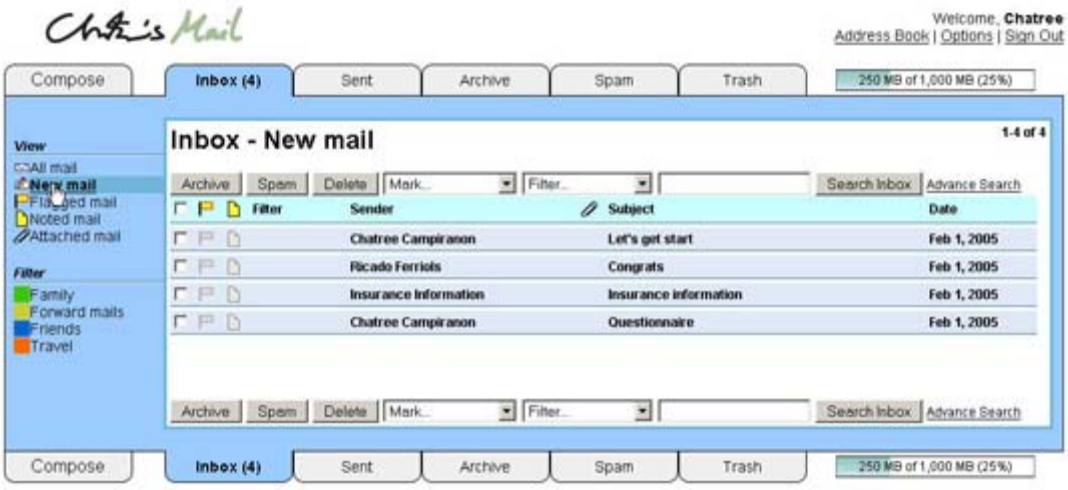

Figure 3-25: New Prototype – New Mail View

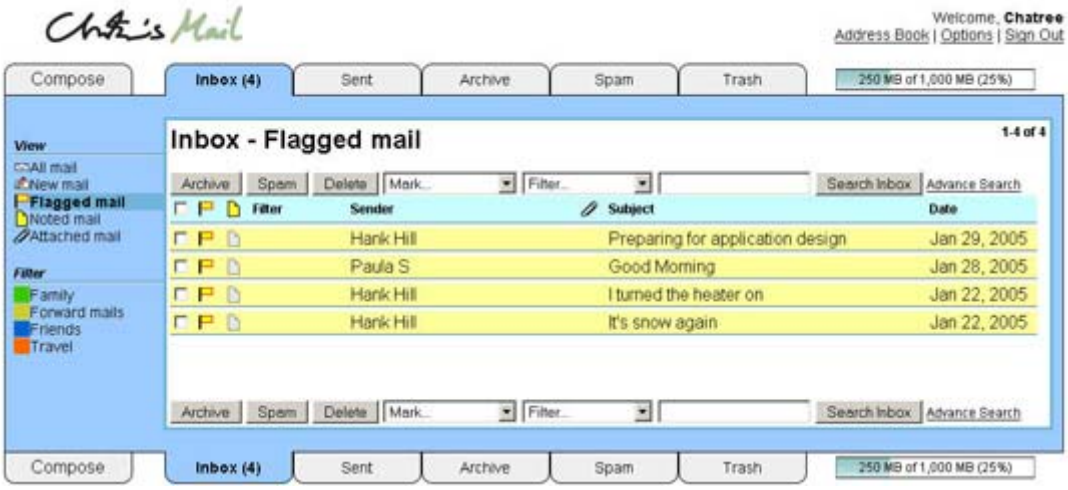

Figure 3-26: New Prototype – Flagged Mail View

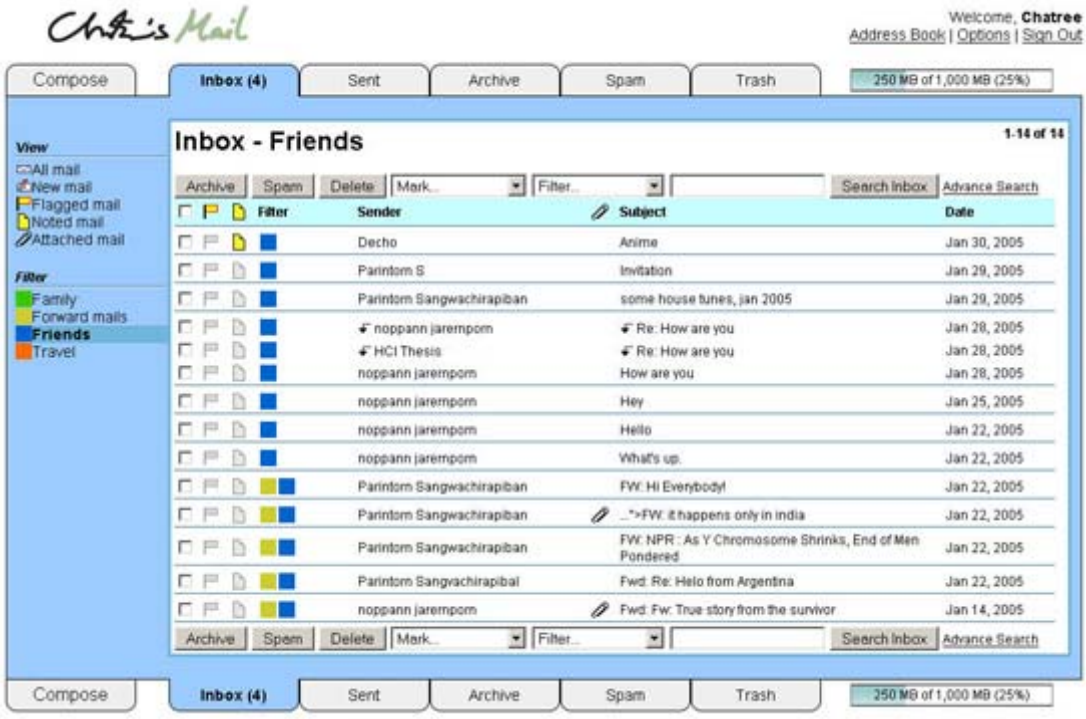

Figure 3-27: New Prototype – Friends Filter

Besides view, there was the filter feature that works similarly to the view feature. The difference was that the filter was the group that users could create manually. Users were able to assign a color to each filter. Users could see the color assigned from the message list (Displayed in Figure 3-24). Gmail offered the label feature, but Gmail displayed the label name in the message list, which might be difficult to read when there were already many texts in the message list. The use of color might improve users' vision to notice messages in any particular filter more easily. When users clicked the filter name on the left side of the screen, emails in that group were be filtered and shown. All the emails in views and filters were not mutually exclusive. However, messages in a folder were exclusive from messages in different folders.

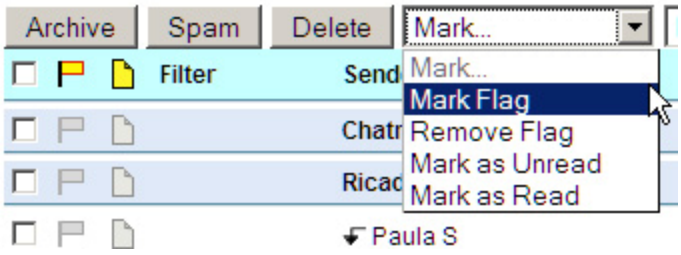

Figure 3-28: New Prototype – Mark Options

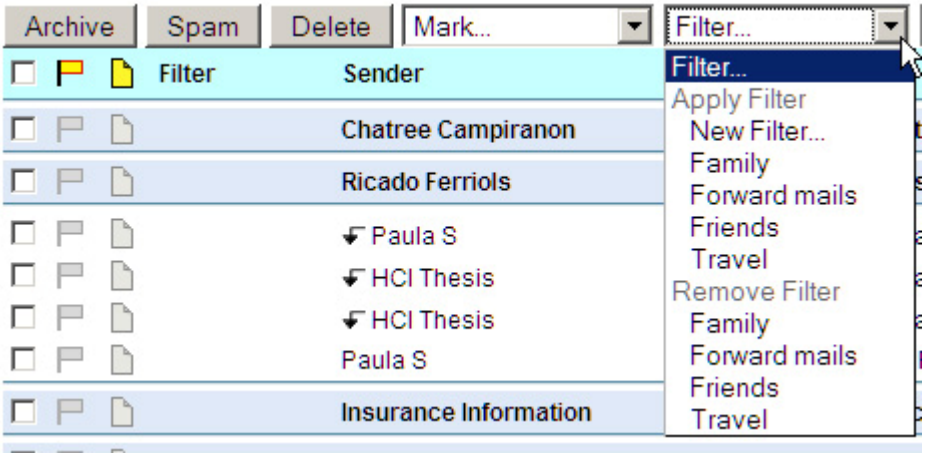

Figure 3-29: New Prototype – Filter Options

Users had to select at least one message in the message list in order to use any of the buttons or menus. Three buttons in the design were self-explanatory. “Archive” put selected messages into the Archive folder. “Spam” put selected messages into the Spam folder. And “Delete” put selected messages into the Trash folder. There were two dropdown menus to use in the new prototype. The first was the “Mark” menu (Figure 3-28). The mark menu consisted of the options “Mark flag,” “Remove Flag,” “Mark as Unread,” and “Mark as Read.” The second menu was “Filter” (Figure 3-29). The filter menu consisted of options to apply “New Filter” or existing (already created) filters. Users could also remove existing filter with “Remove Filter”. Users could apply one filter at a time.

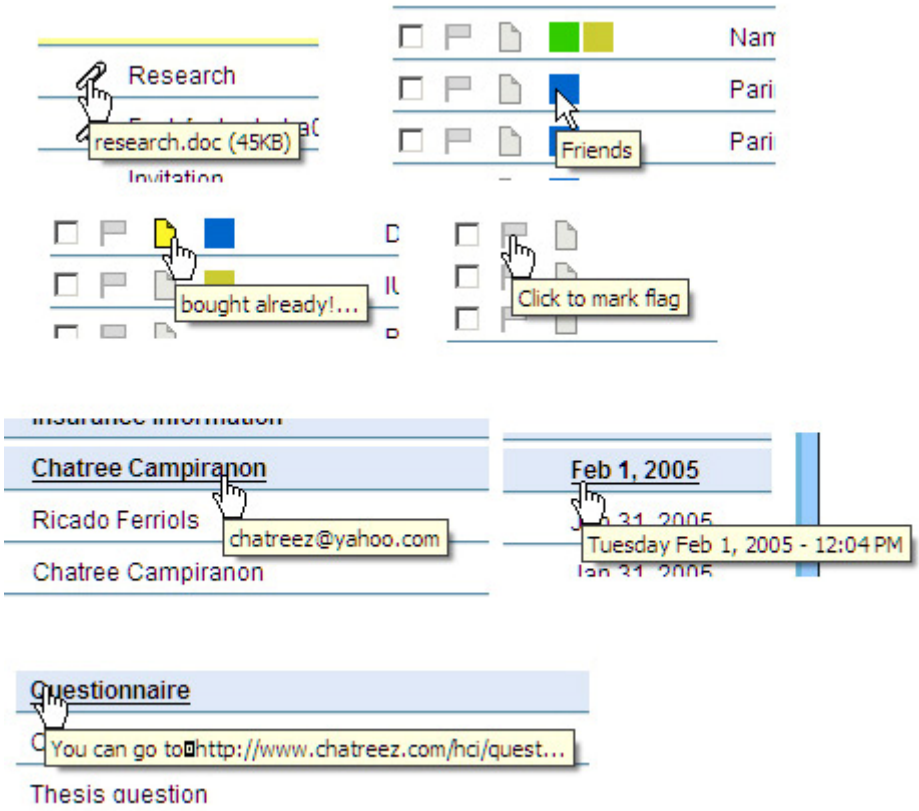

Figure 3-30: New Prototype – Captions

The new interface provided text captions in many area of the message list. Figure 3-30 presents captions in the different areas, such as attachments' name and size, filter name, note written, flag icon tips, sender's email, complete date and time received, and message content. It was an approach to provide valuable hidden information while preventing displaying too much information in one page.

The search box in the new prototype was placed next to the dropdown menus right above the message list to make it more visible to users and encourage them to use the search function. The search system search only emails in the current folder. The description of the search button changed through different folders, for example, "Search Inbox" and "Search Archive." The search result was shown in Figure 3-31. The search system search names, emails and message contents. The advanced search function was not yet developed in the prototype, but users should be able to enter

search terms in different fields such as name, address, content, and folder. There was no “Search the web” button in the interface of the new prototype.

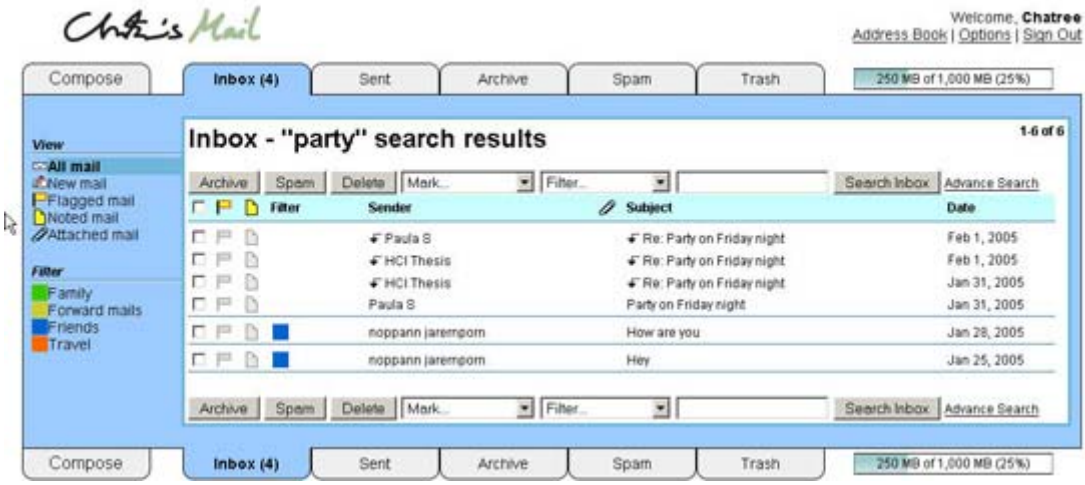

Figure 3-31: New Prototype – Search Result

The message page of the new prototype (Figure 3-32) contained information of received date, from, to, and message content. Sender and recipients were described with full names followed by the email address in parentheses. Buttons and menus were similar to commands provided on the first page. Additional buttons were “Reply,” “Forward,” and “Take note.” The note feature was the task management feature that was designed for the new prototype for the reason that it could support the users’ need more than advanced task management features, such as Calendar, could. Users were able to take note by selecting the “Take note” button and the note box was shown (Figure 3-33) and users could type the note they wanted to take as a reminder for the email message.

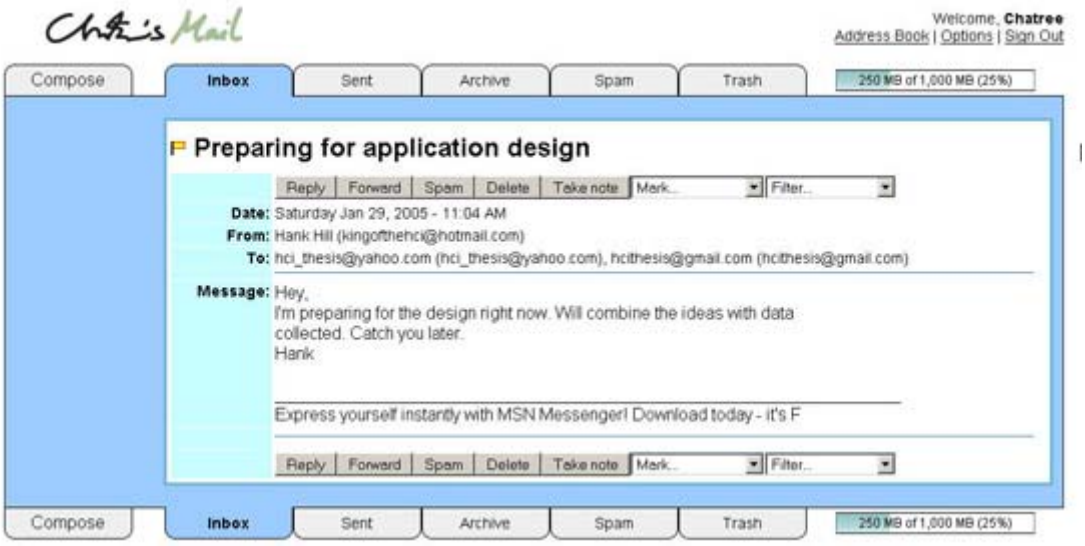

Figure 3-32: New Prototype – Message Page

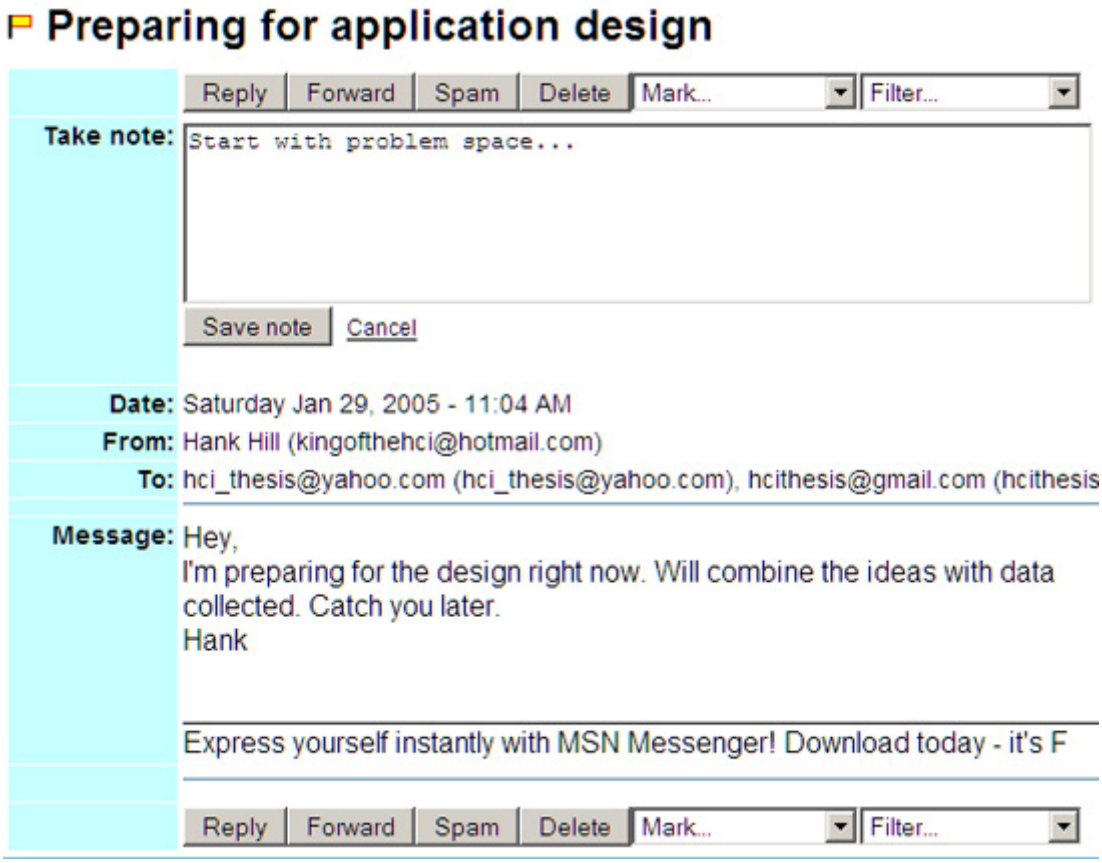

Figure 3-33: New prototype – Taking Note

Figure 3-34: New prototype – Conversational Thread in Message List

The new prototype handled conversational threads by grouping emails in the same conversational thread together in the message list (Figure 3-34). Older messages in the same thread were grouped with the most recent one. The reply messages were indented to the right with a small arrow icon pointing down to indicate that these emails were replies to the original message. Each email in the conversational thread could still be treated as one message. Users could apply flags, notes, or different filters into messages in the same thread while those messages were grouped together. When users clicked any of the messages in the conversational thread, all the messages in the thread was shown on the message page (Figure 3-35). The same approach was applied on the message page where there were commands that could be used for each individual email in the thread. Users could Reply, Forward, Delete, Take note, Mark flag, and Apply filter to any message that was displayed on the message page.

Using the thread grouping feature was another reason why the sort feature was removed from the design. As mentioned before, sort function becomes less effective when there are many messages in the mailbox and it is better to use search function instead of sort. The design of the new prototype sorted emails by date and time received from the most current one to the oldest message. However, there was an exception that older messages could be brought up to be grouped with the most current message in the same thread. If the system allows users to sort messages by sender or subject, the thread grouping feature will not be applied to the message list in the sort result. The outcome might cause the inconsistency issue between different results of message sorting.

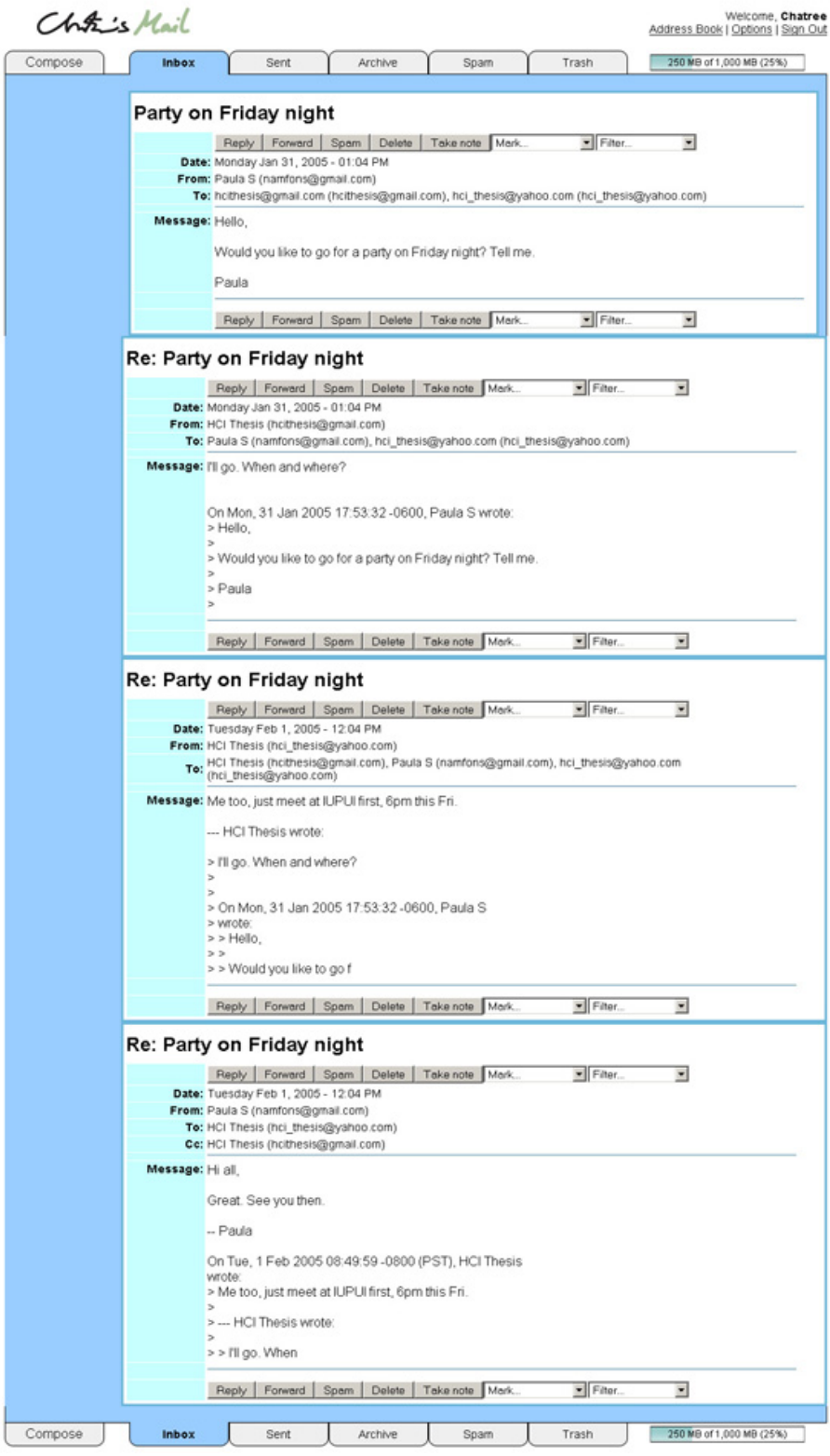

Figure 3-35: New prototype - Opening Conversational Thread

Procedures

The methodological approach consists of the following steps:

Phase 1 – Evaluation of Yahoo! Mail and Gmail:

1. Questionnaire
2. Time-on-task and think-aloud technique
3. Follow-up interview session

Phase 2 – Development of the new email prototype:

1. Analysis of the users' performance and preferences
2. Development of the web-based email prototype

Phase 3 – Evaluation of the new email prototype:

1. Questionnaire
2. Time-on-task and think-aloud technique
3. Follow-up interview session
4. Post-task questionnaire

The users were involved only in Phase 1 and 3. Phase 1 was for collecting data from users to support the design of the new web-based email prototype. Phase 3 was for testing the new prototype. Terms used in the questionnaire were different according to the service the user was testing. For example, Gmail used the term "star" while Yahoo! Mail used "flag." There was no audio or video recording at anytime and users' private information such as name, actual email messages, and actual email screens were not seen or recorded. Since email is an activity that requires privacy, all of the steps that involve users were conducted in individual sessions. The testing mailboxes used in this study were generated by the researcher for the purpose of the

study only and the messages in the mailboxes were not related to any person's private information. The testing mailboxes were not accessible to the public.

In the first phase, the participants were given the questionnaire. The questionnaire consists of 34 questions and contains different sets of questions in the following categories:

- Demographic information
- Computer and Internet experience
- General email experience
- User web-based email experience – contains these following sub-categories:
    - Categorizing email
    - Participating in conversational thread
    - Prioritizing email
    - Archiving and deleting email
    - Using an Organizer/Planner/Schedule (Task management)

After completing the questionnaire, the user conducted the time-on-task testing combined with think-aloud technique. The user was given email-related tasks to perform on the web-based email service. The tasks included email categorizing, email searching, email prioritizing, conversational thread, and task management. While the user performed each task, the user was required to say out loud what he or she thinks about when doing any particular action. The final step of Phase 1 was the follow-up interview. The follow-up interview consisted of questions related to the users' experience in the time-on-task study. The first phase focused on users' performance and preferences on using the existing web-based email service.

Phase 2 focused on analyzing and interpreting data from Phase 1. The researcher combined the information gathered with the knowledge of user email management behavior gained from the literature review to suggest and design a new web-based email prototype that is suitable for dealing with the email overload issue.

Phase 3 was almost the same process as Phase 1 but the users tested the new email prototype that is developed from Phase 2. The study started with a questionnaire and then a time-on-task study on the new prototype. Questions related to users' preference in the follow-up interview were removed but users were given the post-task questionnaire to complete. Phase 3 focused on user's performance and feedback on using the new email prototype.

After three phases of user study, the researcher analyzed the findings of Phase 3 and also completed the report for this study. Discussions and conclusions were added. The comprehensiveness and language of the study was reviewed.

Analysis

The analysis of results from usability testing provided significant information that supported the design of the new web-based email prototype. The same analysis was applied for the evaluation of the new prototype. The analysis consisted of statistical analysis, and content analysis. Statistical analysis was performed for questionnaire and time-on-task studies to analyze quantitative data. Statistics methods used in this study consisted of basic descriptive statistics (Mean, Median, and Standard Deviation) and Mann-Whitney U Test. Content analysis was performed for interview and post-task questionnaire results to analyze qualitative date.

Mann-Whitney U Test

The Mann-Whitney U Test is the nonparametric test employed with ordinal data in a hypothesis testing involving a design with two independent samples (Sheskin, 1997). If the result of the Mann-Whitney U test is significant, it indicates the groups are different.

The Mann-Whitney U Test is based on the following assumptions:

1. Each sample has been randomly selected from the population it represents.
2. The two samples are independent of one another.
3. The original variable observed (which is subsequently ranked) is a continuous random variable.

Unlike other methods such as t-test and Analysis of Variance (ANOVA), the Mann-Whitney U Test doest not require normal standard deviation for the analyzed data. Based on the assumptions of the Mann-Whitney U Test, it was appropriate to use this method to determine whether differences exist among the results from time-on-task studies on three different web-based email services. When the differences were discovered, the interface designs were analyzed to determine why there are differences on the task results.

Content Analysis

The other analysis used in this study is content analysis. It consists of techniques to code or categorize recorded information into a set of descriptive categories. Content analysis reduces data records into a manageable and quantitative form. The idea of content analysis is to examine how much attention is being paid to an idea or topic of concern by counting the number of occurrences of certain words, phrases, events, actions, and/or objects (Lindgaard, 1994). However, due to the time constraint

in this study, there was no audio recording so the exact words and comments were not available to code. Therefore, only the concepts summarized by the researcher will be coded. Content analysis was conducted to analyze data from interview results. Since this post-task interview was a structured interview, concepts were analyzed; also the frequency of occurrence of other concepts in the same interview question was counted. This method was more effective to summarize users' answers and comments for each question. The result of a content analysis led to the summary of users' preferences, issues, expectations, and feelings on using web-based email service.

The following coding rules were used for results from every question but question three and four. Answers in question three and four are only grades and a yes/no question that did not need users' explanations (since users explained their preference in other questions). Questions one through five were designed to collect users' preferences and experiences on the specific email service that he or she has just tested so there will be different content analyses conducted on the results from Gmail users, Yahoo! Mail users, and the new prototype users. Questions six through nine were designed to collect users' preferences and experiences on web-based email usage in users' real life. The content analysis for questions six through nine combine both Gmail users' results and Yahoo! Mail users' results in the same table. Questions six though nine were not being used for the new prototype users because it is less important to gather users' preferences after developing the new prototype. Instead of questions related to preferences, the post-task questionnaire (reported in the Phase 3 section in chapter four) consists of Likert-based questions and open-ended questions to gather more qualitative data on how the users felt about the design of the new prototype.

Coding Rules

Since this study was conducted without audio recording, the level of analysis covers only the concepts, keywords, and phrases from users' answers and comments. Exact words or paragraphs may not be recorded perfectly but the meaning of the concepts and recorded phrases refers to the same meaning as users' words.

General rules:

1. An incident can be a word, a couple of words, a phrase, or a sentence. When there are multiple incidents within one sentence, each incident is coded individually.
2. Some words will be coded in more than one category, according to the contexts where the words are used.

Coding scheme: Thoughts

Code in a category of thoughts if the recorded answers contain comments about:

- Code as an instance of "Experience" if comments are related to users' experience with using emails, experience with using computers, experience with any related problems, etc. Include words such as "usually," "sometimes," "always," "a lot of the time," "once in a while," "normally," "all the time," and "every time."
- Code as an instance of "Comments" if comments are related to users' comments on the tested web-based email service, suggestions, explanations of impressions, etc.

Coding schedule: Feelings

Code in a category of feelings if the recorded answers contain comments about:

- Code as an instance of “Positive” if comments are related to users’ comments about positive feelings for the degree of satisfaction, confidence, effectiveness, ease of use, usefulness, enjoyment, relaxation, etc.
- Code as an instance of “Negative” if comments are related to users’ comments about the degree of anxiety, difficulty, and also negative feelings for the degree of satisfaction, confidence, effectiveness, ease of use, usefulness, enjoyment, relaxation, etc.

CHAPTER FOUR: RESULTS

The results are reported in three main sections. The first section presents the results from Phase 1, the second section presents the results from Phase 3, and the last section presents a comparison of performance from the time-on-task studies in Phases 1 and 3. Phase 1 was the user study on Gmail and Yahoo! Mail. Phase 3 was the user study on the new prototype. No results are reported from Phase 2 because it involved only the development of the new prototype. The development of the new prototype is discussed in the Treatment section in Chapter Three. Detailed comparison of the time-on-task performance and Mann-Whitney U Test results are discussed in the last section of this chapter.

Phase 1

Phase 1 was designed to study the interface of Gmail and Yahoo! Mail. Users' performance and preference results from phase one were analyzed before creating the new prototype in Phase 2. Phase one users had to finish the user profile questionnaire (reported in Participants section in chapter three), a time-on-task study, and an interview. In Phase 1, the interview consisted of nine questions related to the user's experience from the time-on-task study and the user's personal preferences related to using web-based email services.

Time-On-Task Results

After finishing the questionnaire, users participated in the time-on-task session. Each user performed five tasks related to email categorizing, email searching, email prioritizing, conversational thread and task management. Results are displayed in Table 4-1 and 4-2. Numbers in the table are recorded in seconds. "N/A" indicates that the user could not complete that particular task. Users were instructed that they

could give up completing the task when they had tried all methods possible. All users that gave up completing the task spent more than three minutes (180 seconds) which is more than the slowest time recorded (71 seconds). Gmail users are represented with the letter "G" followed by a number from one to 15. Yahoo! Mail users are represented with the letter "Y" followed by a number from one to 15.

User	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**
G1	59	20	5	7	15
G2	29	14	N/A	18	17
G3	27	23	12	14	26
G4	54	63	10	57	N/A
G5	25	31	30	58	61
G6	54	64	13	8	9
G7	71	14	20	15	N/A
G8	14	15	18	11	N/A
G9	44	19	30	8	N/A
G10	10	12	17	54	11
G11	35	14	12	20	21
G12	32	16	15	15	15
G13	27	40	16	9	17
G14	40	13	22	10	29
G15	24	19	7	12	27
Median	32.00	19.00	15.50	14.00	17.00
Mean	36.33	25.13	16.21	21.07	22.55
SD	17.182	17.287	7.485	18.641	14.306

Table 4-1: Gmail Users' Time-On-Task Results from Five Tasks

User	Task 1	Task 2	Task 3	Task 4	Task 5
Y1	21	29	29	15	16
Y2	48	20	22	N/A	11
Y3	18	64	15	32	7
Y4	23	53	17	21	4
Y5	10	43	31	11	13
Y6	61	N/A	49	40	18
Y7	25	30	25	30	14
Y8	13	29	32	20	8
Y9	32	42	23	25	10
Y10	24	N/A	28	46	4
Y11	21	35	35	15	8
Y12	30	33	18	27	5
Y13	38	56	22	48	10
Y14	12	40	30	13	8
Y15	26	45	34	58	12
Median	24.00	40.00	28.00	26.00	10.00
Mean	26.80	39.92	27.33	28.64	9.87
SD	13.744	12.433	8.641	14.563	4.207

Table 4-2: Yahoo! Mail users' Time-On-Task Results from Five Tasks

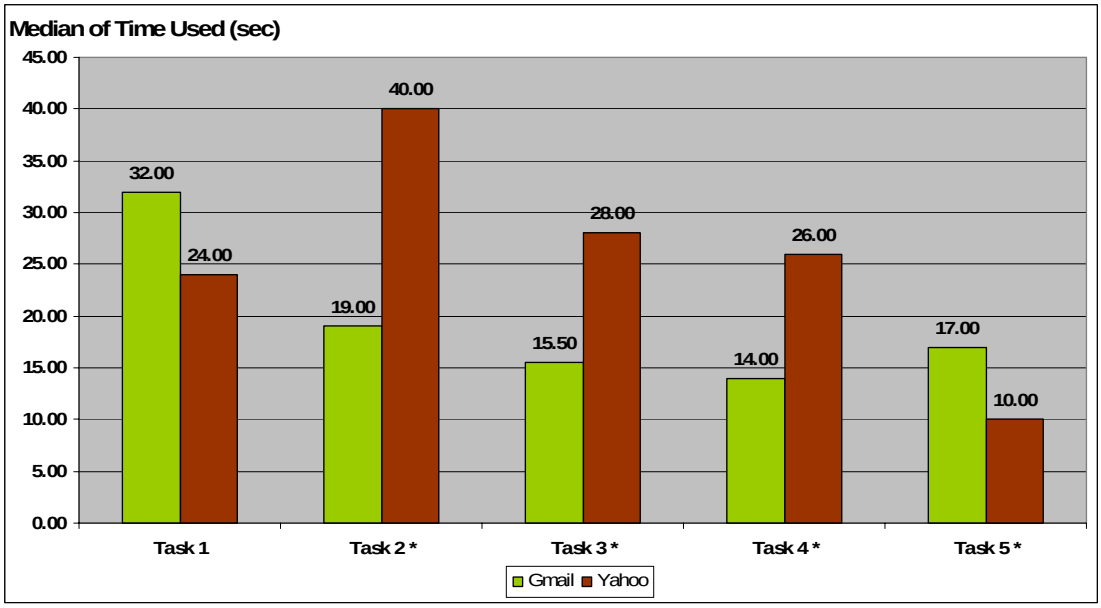

Figure 4-1: Median of Time Used - Gmail and Yahoo! Mail

Figure 4-1 presents the medians of time used in the time-on-task study. The asterisk (*) signs indicate there is a significant difference between Gmail and Yahoo! Mail users result in Tasks 2, 3, 4, and 5. As intended, task one was given to users for them only to explore the interface in the web-based email service so that there was no

significant difference between Gmail and Yahoo! Mail results in this task. Later in this chapter, detailed comparison of the time-on-task performance and Mann-Whitney U Test results are discussed in the comparison of performance from the time-on-task studies in Phase 1 and 3 sections.

Interview Results

Results from Question One

"What was your immediate impression of the interface of this email service?"

Category	Occurrences	Words or phrases
Comments	8	It's new.
	8	There is no advertisement like other email service.
	2	The entire row of message can be clicked.
	1	There are green texts, bold texts, and normal texts.
	1	Very simple even there are 50 messages in one page.
Experiences	5	Use the same color theme as Yahoo! Mail.
	2	I have used emails with ads.
Positive feeling	3	Nice and clean look, very simple even there are 50 messages in one page.
	1	Menu on the left hand side is easy to use.
Negative feeling	7	Too many texts on the screen because part of messages are displayed after a subject.
	6	Confused.
	6	Interface looks strange.

Table 4-3: Content Analysis Results of Question One - Gmail

Table 4-3 presents content analysis results of Gmail users' data from Question one. The effects of Gmail using many new features cause both positive and negative responses from users. One important issue is excessive text on the screen. Another important issue is that users wanted to see more graphics. Primarily, these issues come from Gmail's reliance on text.

Category	Occurrences	Words or phrases
Comments	2	May never use some feature like calendar.
	1	Search is useful.
Experiences	1	Not a big different from Hotmail.
Positive feeling	12	User friendly, comfortable, and easy to use.
	7	Nice color and placement.
	3	Looks professional.
Negative feeling	6	Too many advertisements.
	5	Too many buttons and menus.

Table 4-4: Content Analysis Results of Question One – Yahoo! Mail

Table 4-4 presents content analysis results of Yahoo! Mail users' data from question one. Users liked the interface of Yahoo! Mail. They did not like advertisements and some of them commented that there are too many functions and menus, and that some of the functions, such as the Calendar, may not be used.

Results from Question Two

"What did you like the most and the least about this email service?"

Category	Occurrences	Words or phrases
Comments	8	1 GB of capacity is big.
	9	There should be a delete button.
	5	There should be a sort feature.
	5	Too many texts on a screen.
	5	Conversational thread grouping is good.
	4	The preview of content is useful.
	3	Gmail should make it to the public.
	3	Interface is too crowded since I can see every message from the inbox.
	2	The label should not being placed next to subject.
	1	The date format should be easier to read, for example, "Mar 21, 05"
Experiences	1	I usually sort by name and by subject.
Positive feeling	8	I like the capacity
	5	Conversational thread grouping is good.
	4	I like the preview of the contents.
	4	I like the idea of label.
Negative feeling	9	I don't like that there is no delete button.
	5	I don't like that there is no sort feature.
	5	I don't like the interface that it is too crowded.
	3	I don't like that Gmail is not made public.
	2	I don't like the placement of labels before subjects.
	2	I don't like the preview of the contents.
	1	I don't like the date format used in Gmail.

Table 4-5: Content Analysis Results of Question Two – Gmail

Table 4-5 presents content analysis results of Gmail users' data from question two. Storage space was the feature that most Gmail users liked. However, the fact that Gmail has no delete button and no sort feature caused negative feedback from most users. Previewing message content in the main mailbox screen is useful but it can also cause the issue of too much information on a screen.

Category	**Occurrences**	**Words or phrases**
Comments	1	I don't understand "Draft" folder.
Experiences	0	-
Positive feeling	12	User friendly, comfortable, and easy to use. I like the "empty trash" icon. It's easy to access.
Negative feeling	6 3	Too many advertisements Sign out link is too small.

Table 4-6: Content Analysis Results of Question Two – Yahoo! Mail

Table 4-6 presents content analysis results of Yahoo! Mail users' data from question two. The negative feelings from Yahoo! Mail users were considerably lower than those of Gmail users. Yahoo! Mail users liked the interface of Yahoo! Mail. Some users complained about advertisements and the small sign out link.

Results from Question Three

"How would you grade how easy it was to use – A, B, C, D, or F? (A is the easiest)"

Grade given	**N Yahoo! Mail**	**% Yahoo! Mail**	**N Gmail**	**% Gmail**
A	6 users	40%	1 user	6.67%
B	9 users	60%	11 users	73.33%
C	0 user	0%	3 users	20%
D	0 user	0%	0 user	0%
F	0 user	0%	0 user	0%
Average Grade	3.4 or B+		2.86 or B-	

Table 4-7: Results from Question Three - Gmail and Yahoo! Mail

Table 4-7 presents users' grading results from question three. Users graded the system based on how easy it was to use, in other words, how user-friendly the

interface was. After calculating the grade point (by assuming A=4, B=3, C=2, D=1, and F=0), Yahoo! Mail scores 3.4 or nearly B+, Gmail gets a lower score at 2.86 or nearly B-.

Results from Question Four

"Did you understand how to use the basic menus and buttons right away?"

Answer	N Gmail	% Gmail	N Yahoo! Mail	% Yahoo! Mail
Yes	7 users	46. 7%	12 user	80%
No	8 users	53.3%	3 users	20%

Table 4-8: Results from Question Four - Gmail and Yahoo! Mail

Table 4-8 presents users' grading results from question four. While 80% of Yahoo! Mail users answered yes, only 46.67% of Gmail users answered yes. The cause of the problems for Gmail users were issues revealed in question one and two. Gmail implements many new features with which users are not familiar. The uses of label, conversational thread grouping, and the absence of sort function and delete buttons are the issues that caused problems to users.

Results from Question Five

"What were the biggest problems you found on the previous test?"

Task	N Gmail	% Gmail	N Yahoo! Mail	% Yahoo! Mail
1	4 users	26.67%	1 user	6.67%
2	0 user	0%	11 users	73.33%
3	2 users	13.3%	3 users	20%
4	3 users	20%	0 user	0%
5	6 users	40%	0 user	0%
None	0 user	0%	0 user	0%

Table 4-9: Results from Question Five - Gmail and Yahoo! Mail

Table 4-9 presents results from question five. For Gmail users, the biggest problem was task five – deleting a message. Gmail does not provide a delete button and this caused problem for users. The biggest problem for Yahoo! Mail users was

task two – email search in a category. Yahoo! Mail uses folders and this causes a visibility issue because the users cannot see messages that have been assigned to a folder.

Results from Question Six

"Any comments on features that you want to use on the web-based email service but doesn't exist?"

Category	Occurrences	Words or phrases
Comments	10	A better way to handle attachments.
	7	More automatic filter such as from or length.
	5	Sub-folders in address books.
	5	Video mail - easier way to send a video message.
	3	Recall - Cancel mails that's have already been sent.
	2	Check box to choose if the sent message is going to send folder or not.
	1	Alert when receive emails from someone even the mailbox is full.
	1	Want the feature that assigns one email into more than one category.
	1	Search words in email contents.
Experiences	6	Current email is good enough and needs no improvement.
Positive feeling	0	-
Negative feeling	3	I don't like the idea of setting expiration date.

Table 4-10: Content Analysis Results of Question Six

Table 4-10 presents content analysis results of question six. Feedback from the users for this question was lower than feedback from other questions. Many users stated that they do not think of a new feature because they are users, not designers. However, there are still many remarkable ideas from users that may be considered in the design of a web-based email interface. Automatic filters will be an appropriate idea to implement or suggest in this study.

Results from Question Seven

"Could you explain your habit of using search function in web-based email?"

Category	Occurrences	Words or phrases
Comments	1	I may want to use if the email service doesn't provide folder.
Experiences	16	Always do the manual search.
	13	Rarely use search function.
	10	Never use search function.
	9	Search manually first, if I can't find, then I'll do the search function.
	8	Hotmail doesn't provide search function.
	8	Never noticed that there is a search box to use.
	8	I am familiar with my own mailbox so I don't need to search.
	6	Use folder/label to make it easier to search.
	4	Use flag to make it easier to search.
	4	Use "Ctrl+F" to find messages.
	2	Sometimes it is hard to choose the search string if I can't remember the subject.
	1	I have a few mails and don't need to search at all.
	1	I use only search in Outlook.
Positive feeling	0	-
Negative feeling	1	It's hard to enter good search query when the search is complicate.

Table 4-11: Content Analysis Results of Question Seven

Table 4-11 presents content analysis results of question seven. It is obvious that most users prefer to search messages manually. Some of the users mentioned that Hotmail does not provide a search function. Some users never noticed that there is a search box to use. As mentioned in the Gmail and Yahoo! Mail review section, the placement of the search box can encourage the search activities if users notice the search box more easily. A common strategy used for email searching for this group of participants is they search the message manually first, then if they cannot find the message, they will use the search function. Some of the users also create email categories or mark flags to make it more convenient to access important messages.

Results from Question Eight

"Could you explain your habit of deleting mail messages?"

Category	Occurrences	Words or phrases
Comments	4	It is good that many web-based email services provide large storage.
Experiences	23	Usually delete junk mails without opening them.
	13	Keep almost everything that is not junk mails since I have large storage.
	12	I keep unused email in order I have to use it in the future.
	10	Keep mails from people I know.
	9	Clear mailbox in between 1 week - 3 month period.
	9	Delete unimportant mail with large attachments.
	8	I'm too lazy to delete mails everyday.
	8	I look for the sender's name and subject to determine if it's a spam or not.
	6	If I don't delete mails, I'll move those mails into folders.
	5	I open mails, read them, if I don't use them, I'll delete right away.
	2	My inbox contains only new messages.
	1	I delete email daily at work.
	1	I save important message with MS Word before delete.
Positive feeling	4	It is good that many web-based email services provide large storage.
Negative feeling	0	-

Table 4-12: Content Analysis Results of Question Eight

Table 4-12 presents content analysis results of question eight. The most common behavior for deleting emails is users often delete junk mail without opening them. Users use sender's name and subject as a criterion to determine junk emails. Users tend to keep other emails, especially if they were sent from known people, while the storage space is not full. Users who keep unused emails may delete or clear the inbox once in a while (in the range of one week to three months). However, with the larger storage space offered nowadays, users tend to keep more messages.

Results from Question Nine

"Could you explain your habit of using planner/schedule function in web-based email?"

Category	Occurrences	Words or phrases
Comments	1	There should be a function that manages a group schedule that group members can access.
Experiences	15	Never use it.
	8	I've already had a book planner.
	6	I use email only for handling email.
	5	Rarely use it.
	5	I've never used any type of planner before.
	3	I've already had a PDA.
	3	Schedule is something that I need to carry, but web mail needs internet to access.
	3	I use planner in Outlook.
	2	I always use web-based email calendar.
	1	I use www.birthdayalarm.com.
	1	Scheduling is time-consuming activity; it should not be combined in email.
Positive feeling	0	-
Negative feeling	0	-

Table 4-13: Content Analysis Results of Question Nine

Table 4-13 presents content analysis results of question nine. Half of the users never use the task management feature such as planner or calendar in the web-based email services. Many users use different media, which are books, PDA, or Outlook, to manage their schedule. The remarkable point is a planner is something that a person needs to carry and read anywhere and anytime he or she wants. But a planner in the web-based email service requires access to the Internet. Thus, it may not be a good choice to use a task management feature in a web-based email service.

Phase 3

Phase 3 was designed to study the new interface. Users' performance and feedback results were compared with results from Phase 1. Phase 3 users had to finish the user profile questionnaire (reported in Participants section in chapter three), a time-on-task study, an interview, and a post-task questionnaire. In this phase, interview questions consisted of five questions related to user's experience from the

time-on-task study. The post-task questionnaire was given to users in Phase 3 in order to gather qualitative data related users' feedback on the new interface.

Time-On-Task Results

The new prototype users are represented with the letter "N" followed by a number from one to 15. Unlike Phase 1, in which some users could not finish some tasks, every user in Phase 3 finished all five tasks in less than one minute per task. The time-on-task results in Phase 3 are presented in Table 4-14.

User	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**
N1	23	26	8	20	16
N2	23	12	4	12	18
N3	13	50	17	45	5
N4	52	10	8	16	8
N5	40	16	2	14	8
N6	29	18	10	10	12
N7	39	40	16	20	7
N8	53	46	4	11	12
N9	20	23	7	14	13
N10	26	15	14	17	8
N11	32	17	6	25	6
N12	25	28	12	31	10
N13	21	38	7	17	12
N14	17	14	6	11	13
N15	23	26	8	20	16
Median	25.00	23.00	8.00	16.00	10.00
Mean	28.80	25.20	8.73	18.53	10.47
SD	12.178	12.768	4.431	9.242	3.681

Table 4-14: New Prototype Users' Time-On-Task Results from Five Tasks

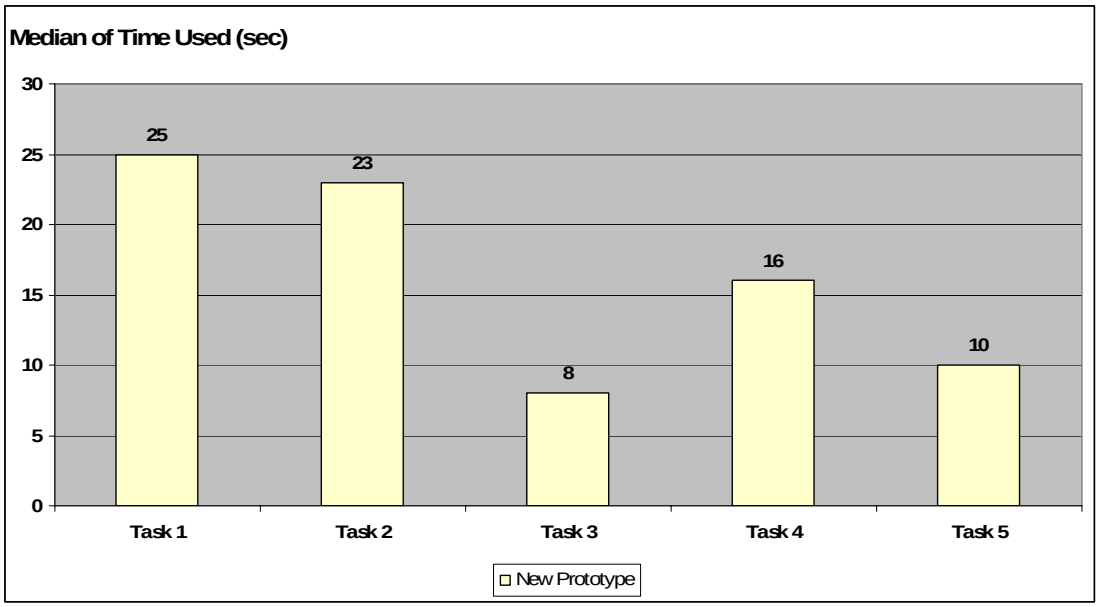

Figure 4-2: Median of Time Used - New Prototype

Figure 4-2 presents median of time used for the tasks in Phase 3. As stated in Phase 1 results, a detailed comparison of the time-on-task performance and Mann-Whitney U Test results are discussed in the comparison of performance from the time-on-task studies is presented in a later section.

Interview Results

Results from Question One

"What was your immediate impression of the interface of this email service?"

Category	Occurrences	Words or phrases
Comments	3	Colorful filter
	2	Looks new
Experiences	7	Looks similar to other email services
Positive feeling	8	Color is nice
	7	Layout is nice
	5	Simple
	1	Buttons are easy to find
	1	Nice logo
Negative feeling	4	Color filter is confusing
	4	Don't like the color
	1	Not professional

Table 4-15: Content Analysis Results of Question One – New Prototype

Table 4-15 presents content analysis results of the new prototype users' data from question one. Many users liked the color and layout of the new prototype. Some users did not like the color, especially color filters. Many users mentioned that the interface looks similar to other email services.

Results from Question Two

"What did you like the most and the least about this email service?"

Category	Occurrences	Words or phrases
Comments	1	It's new idea to group messages together
Experiences	0	-
Positive feeling	6	I like the caption texts (some people called 'tool tips')
	4	I like the simple color
	4	I like the thread grouping feature
	3	I like the filter feature
	3	I like that the search box is easy to locate
	3	I like the note feature
	1	I like that there are many useful features
	1	I like the "Attached mail" view
Negative feeling	4	I don't like the color used in the interface
	1	I don't like the terminology of "view"

Table 4-16: Content Analysis Results of Question Two – New Prototype

Table 4-16 presents content analysis results of the new prototype users' data from question two. Like Yahoo! Mail, the negative feelings from the new prototype users were considerably lower than those of Gmail users. The new interface users like the features of the new prototype. Four users did not like the color used in the interface while there were also four users who liked the color.

Results from Question Three

"How would you grade how easy it was to use – A, B, C, D, or F? (A is the easiest)"

Grade given	N Yahoo! Mail	% Yahoo! Mail	N Gmail	% Gmail	N new prototype	% new prototype
A	6 users	40%	1 user	6.67%	9 users	60%
B	9 users	60%	11 users	73.33%	6 users	40%
C	0 user	0%	3 users	20%	0 user	0%
D	0 user	0%	0 user	0%	0 user	0%
F	0 user	0%	0 user	0%	0 user	0%
Average Grade	3.4 or B+		2.86 or B-		3.6 or A-	

Table 4-17: Results from Question Three – New Prototype

Table 4-17 presents the summary of results from question three. Results from Phase 1 are included in the table for comparison purposes. The new prototype was designed after the analysis of both Yahoo! Mail and Gmail so that it received the highest score on the ease of use as intended.

Results from Question Four

"Did you understand how to use the basic menus and buttons right away?"

Answer	N Gmail	% Gmail	N Yahoo! Mail	% Yahoo! Mail	N new prototype	% new prototype
Yes	7 users	46. 7%	12 user	80%	13 users	86.7%
No	8 users	53.3%	3 users	20%	2 users	13.3%

Table 4-18: Results from Question Four – New Prototype

Table 4-18 presents the summary of results from question four. Results from Phase 1 are also included in the table for comparison purpose. 86.7% of the new prototype users answered yes. This indicates that the design of the menu and buttons was successful in improving usability.

Results from Question Five

"What were the biggest problems you found on the previous test?"

Task	N Gmail	% Gmail	N Yahoo! Mail	% Yahoo! Mail	N new prototype	% new prototype
1	4 users	26.67%	1 user	6.67%	8 users	53.3%
2	0 user	0%	11 users	73.33%	0 user	0%
3	2 users	13.3%	3 users	20%	0 user	0%
4	3 users	20%	0 user	0%	1 user	6.7%
5	6 users	40%	0 user	0%	1 user	6.7%
None	0 user	0%	0 user	0%	5 user	33.3%

Table 4-19: Results from Question Five

Table 4-19 presents the summary of results from question five. Results from Phase 1 are also included in the table for comparison purposes. The biggest problem for the new prototype was task one – applying new filter. The design of the new prototype does not provide a link to create a new filter at the filter group on the left side of the screen but only provides a command under the dropdown menu. There should be a link to create or edit filters near the group of filters on the left side of the screen. Five users of the new prototype did not have any trouble completing any task.

Post-Task Questionnaire Results

The post-task questionnaire (see Appendix H) was designed to gather users' feedback on the new prototype only (not Yahoo! Mail and Gmail). The questionnaire contains two parts of questions. The first part contains Likert-based questions related to the design and feature of the new interface. The second part contains open-ended questions where users can write their opinions of positive and negative aspects along with suggestions for the new interface. The results from the first part of the post-task questionnaire are summarized in Table 4-20 and Table 4-21.

Legend:

SA = Strongly Agree, A = Agree, N = Neither, D = Disagree, SD = Strongly Disagree

Questions related to general design of the interface	**SA**	**A**	**N**	**D**	**SD**
1. The amount of text and graphics on the Web site is appropriate.	60%	26.7%	13.3%	-	-
2. The use of color is appropriate.	53.3%	26.7%	13.3%	6.7%	-
3. The text and graphics are presented in a visually aesthetic manner.	26.7%	53.3%	13.3%	6.7%	-
4. The terminology is understandable throughout the site.	40%	53.3%	6.7%	-	-
5. The buttons and menus are easily understood.	73.3%	26.7%	-	-	-
6. The buttons and menus are easily located	60%	40%	-	-	-
7. The design is consistent through out the site.	100%	-	-	-	-
8. The design provides information on where you are on the Web site.	73.3%	26.7%	-	-	-
9. Overall, pages are quick to load.	73.3%	26.7%	-	-	-
10. Overall, the design of the Web site is attractive.	26.7%	40%	26.7%	6.7%	-

Table 4-20: Post-Task Questionnaire Data Summary I

Table 4-20 summarizes results from questions related to general design of the interface. The overall feedback regarding the design of the new prototype is positive. Most users answered “Strongly agree” and “Agree.” Every user strongly agreed that the design is consistent throughout the site. Areas of the new prototype that should be improved are the use of color, graphics, and terminology (such as view and filter).

Questions related to features of the interface	SA	A	N	D	SD
1. The view/filter is easy to use.	73.3%	26.7%	-	-	-
2. The categorizing function is efficient. (It is easy to manage and locate messages in categories.)	60%	40%	-	-	-
3. It is easy to view a particular type of messages. (For example, new messages, flagged/starred messages)	73.3%	26.7%	-	-	-
4. It is easy to read/locate all the messages in the same conversational thread. (Original message and Re: messages)	86.7%	13.3%	-	-	-
5. It is easy to mark flag on email messages.	100%	-	-	-	-
6. It is easy to mark email messages as unread.	53.3%	46.7%	-	-	
7. The search box is easily located.	100%	-	-	-	-
8. The archive feature is useful.	13.3%	73.3%	13.3%	-	-
9. The archive feature is easy to use.	60%	40%	-	-	-
10. The note feature is useful.	53.3%	40%	6.7%		
11. The note feature is easy to use.	73.3%	13.3%	13.3%		

Table 4-21: Post-Task Questionnaire Data Summary II

Table 4-21 summarizes results from questions related to features of the interface. Overall, feedback related to feature is better than feedback related to the design. There is no user who answered “Disagree” on the feedback-related questions. Every user answered that it is easy to mark flags on email messages and that the search box is easily located. Although the users felt that the archive feature and note feature are easy to use, they mentioned that they might not have to use those feature much. As a result, only 13.3% of the users strongly agreed that the archive feature is useful and about half (53.3%) of the users strongly agreed that the note feature is useful.

The second part of the post-task questionnaire consisted of three open-ended questions where the new prototype users could write down their own opinions about the new prototype. Results in this part were summarized using the content analysis technique.

Category	Occurrences	Words or phrases
Negative feeling	7	There is no feedback after deleting message or applying filter to messages.
	4	The color is not professional.
	3	There are some bugs in the site.
	2	There is no introduction or help page.
	1	The search engine is too sensitive.
	1	Inappropriate positioning of newly introduced feature such as note.
	1	Priority of flag should be higher than unread.

Table 4-22: Content Analysis Results of Question Related to Negative Factor

Table 4-22 presents content analysis results of questions related to negative factors. The biggest problem that many users mentioned is that there is no feedback after deleting a message or applying filters to messages. Four users complained that the color is not as professional as other email services. One suggestion is to display the note in the special area with a border to distinguish the note from the message. Another complaint from one user was when he marked the flag to an unread message; the message's row was highlighted in blue (as unread message) not yellow (as flagged message). This user suggested that the flag property should have higher priority than the unread property.

Category	Occurrences	Words or phrases
Positive feeling	9	The captions (tool tips) are useful.
	9	The note feature is useful.
	8	Good layout.
	8	The thread grouping feature is useful.
	7	The filter feature is useful.
	5	It is a good idea to use color for filter.
	4	Good color.
	1	Good content grouping
	1	Simplicity

Table 4-23: Content Analysis Results of Question Related to Positive Factor

Table 4-23 presents content analysis results of questions related to positive factors. Positive factors consist of factors related to both features and design. The caption texts (some users called “Tool Tips”) and the note feature are the features that users considered the most useful. Two users used the word “Impressive” to describe their feelings about the note feature. Users liked the layout of the new prototype. The layout means the placement of buttons, menus, folders, views, and messages. They mentioned that the layout is not very different from other web-based emails such as Yahoo! Mail. The thread grouping and filter feature were also considered useful by many users. Some users thought that it is a good idea to use color for filter. However, since the use of color was also considered as a negative factor in the design, there should be further consideration of the use of color before concluding that the use of color is appropriate.

Category	Occurrences	Words or phrases
Comments	3	There should be a feedback after issuing command in the email system (such as deleting or applying filter).
	3	The filter feature allows users to upload their own icons in addition to the color.
	1	There should be a “search Web site” feature”
	1	Emails conversation thread should be grouped into one row with an option to expand or collapse the list of messages in the same thread.
	1	Being able to read all kinds of language is important.
	1	There should be an option to display line numbers of the email message.
	1	The interface should allow users to upload their own logo instead of using the original logo.
	1	Users should be able to customize messages from particular persons (such as family members) to be shown in the first page (before the users can see other incoming mails).

Table 4-24: Content Analysis Results of Comments and Suggestions

Table 4-24 presents content analysis results of comments and suggestions. Unlike other responses from the first two questions, comments and suggestions are not likely to be the same among users. Some suggestions are very interesting and can improve the design. There are suggestions from three users that there should be feedback after they issued a command in the email system (such as deleting or applying filter). Some suggestions are related to others. There are suggestions that users should be allowed to upload their own icons for the filter feature. Also, one user suggested that users should be allowed to upload their own logo instead of using the original logo. The same user also suggested that users should be allowed to customize the first page of the email and filter only incoming messages from specific people such as family members. These suggestions reflect the needs of users to customize the email system as they want. However, by allowing users to customize the interface, the issue that should be taken for consideration is how to keep the interface consistent while letting users customize the logos, icons, and colors.

Comparison of Time-On-Task Results from Phase One and Three

Time-on-task results from Phase 1 and 3 were analyzed and compared to explain differences among the three web-based email services. Results were compared from task one to task five. Also, the use of a search function in the time-on-task study was reported to determine whether the new prototype results in more use of a search function than the interface of Gmail and Yahoo! Mail.

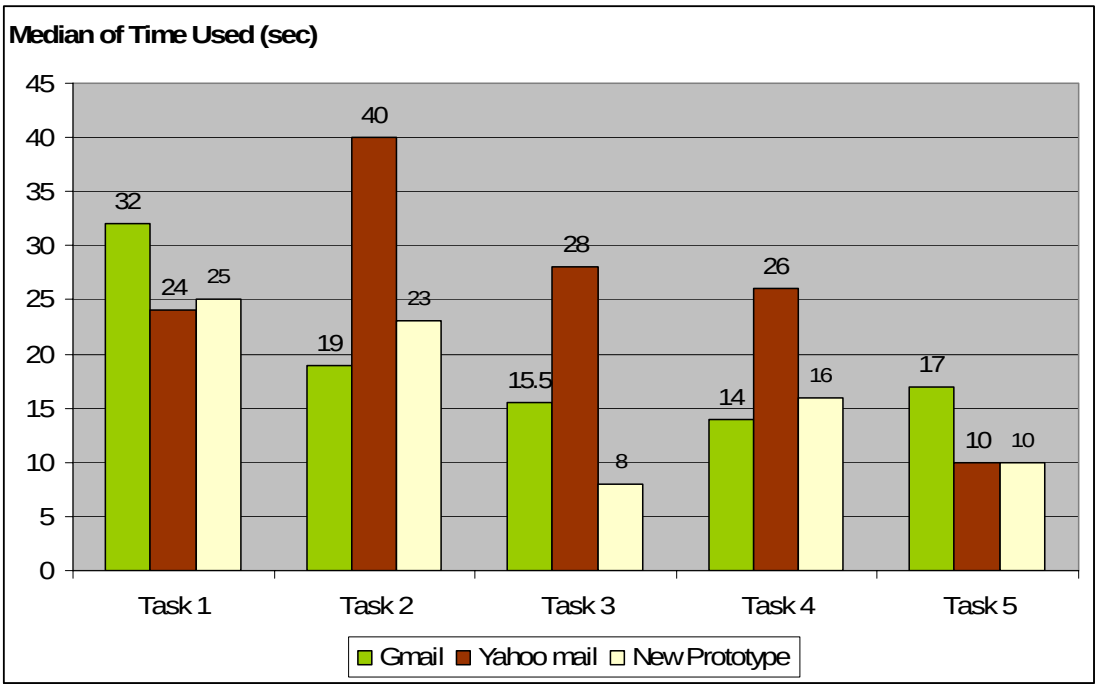

Figure 4-3: Comparison of Medians from Time-On-Task Results

Figure 4-3 compares the medians of time consumed to finish each task. The statistical approach used to measure the differences is the Mann-Whitney U Test. The null hypothesis and alternative hypothesis for this study are:

Null hypothesis: "the time-on-task result for one email service equals the time-on-task result for another email service."

Alternative hypothesis: "the time-on-task result for one email service is different from the time-on-task result for another email service."

If the p value (2-tailed) from the Mann-Whitney U Test is lower than 0.05, the null hypothesis is rejected, and there is a difference between the results of the two groups of users.

Results from Task One

Task one was designed for email categorization issue. The main focus was to measure the users' results and responses to the procedure to create the new email category. The task was: "Move three most recent emails from the sender 'Chatree Campiranon' into new folder named 'From Chatree'."

The difference among emails' interfaces on this issue is that Gmail uses the term "Label," Yahoo! Mail uses the term "Folder," and the new prototype uses the term "Filter." Gmail users have to click on the menu "More actions" to access the command "Apply label," Yahoo! Mail users have to click on the menu "Move" to access the command "New folder," and new prototype users have to click on the menu "Filter" to access the command "Apply new filter." The difference is the terminology used in each email service. Table 4-25 summarizes descriptive statistics of results from task one. Valid N presents the number of users that completed the task. In some cases, some users were not able to complete the task and the results for these users were not included in the statistical analysis. Values for mean, median, minimum, and maximum are recorded in seconds. The lower the value means the shorter the time it took users to complete the task, which indicates better performance on completing the task.

User	Valid N	Mean	Median	Minimum	Maximum	SD
Gmail	15	36.33	32	10	71	17.18
Yahoo!	15	26.80	24	10	61	13.74
New P.	15	28.80	25	13	53	12.18

Table 4-25: Descriptive Statistics of Results from Task One

The mean of Yahoo! Mail is lower than that of Gmail. Comments and responses from users are listed below:

Comments and responses from Gmail users:

- Four users tried to sort the inbox by sender's name but Gmail does not provide a sort function.
- Three users mentioned that Gmail inbox contains too many texts and it is hard to find any particular message in this condition.
- Three users had trouble finding the right way to apply a new label. They clicked the label name on the left side of the screen but did not get the right outcome.

Comments and responses from Yahoo! Mail users:

- Two users used the sort function to sort by name and then by date to select the messages.
- One user mentioned that he feels unfamiliar with the Yahoo! Mail interface.

Comments and responses from the new prototype users:

- Seven users mentioned that the interface is new, but they could finish the task.
- Two users tried to sort the inbox by sender's name.

The result of time-on-task study from task one was then analyzed using Mann-Whitney U Test to measure if there is a significant difference in the results from Gmail, Yahoo! Mail, and the new prototype. Table 4-26 presents the results of the Mann-Whitney U Test from task one.

Comparison	Task 1: p value (2-tailed)
Gmail – Yahoo! Mail	0.71
Gmail – New Prototype	0.12
Yahoo! Mail – New Prototype	0.60

Table 4-26: Mann-Whitney U Test Significant Results from Task One

Since all the p values are higher than 0.05, the null hypothesis can not be rejected. There is no significant difference between any of the web-based email services. The difference of terminology used does not affect the results of users on creating a new category and every user can complete the task.

Results from Task Two

Task two was designed for email categorizing and searching issues. The main focus was to measure users' results and responses to locate an email that was assigned to a particular category. The task was: "Open the message 'Vacation plan' from the sender 'Paula S'."

The message was assigned to "Travel" category. Each web-based email service provides a different concept of categorizing. Gmail uses labels to assign categories to emails. The new prototype applies a similar idea by using folders for email categorization. The result of using labels can be explained as a "view" or a "filter" that the message still exists in the inbox but users can choose labels to filter the list of messages to display only the selected category. The result of using labels can improve performance on email searching since users can see or search any message in any category from the inbox. However, keeping all messages in the inbox can cause the issue of too much information in a screen. Yahoo! Mail uses folders to assign categories to emails. The concept is similar to file management in computers. One message can be in one folder at a time. Once the folder is assigned to a message, users cannot see that message from the inbox, which can lower the performance on

email searching. However, with the folder usage, the inbox is cleaner and users can see messages that are not assigned in any folder more easily. Table 4-27 presents descriptive statistics of results from task two.

User	Valid N	Mean	Median	Minimum	Maximum	SD
Gmail	15	25.13	19.00	12	64	17.287
Yahoo!	13	39.92	40.00	20	64	12.433
New P.	15	25.20	23.00	10	50	12.768

Table 4-27: Descriptive Statistics of Results from Task Two

The mean of results of Gmail was lower than that of Yahoo! Mail and the new prototype. Two Yahoo! Mail users could not find the message since they did not realize that the message was in a folder. Gmail and the new prototype users could see the messages easily in the inbox.

Comments and responses from Gmail users:

- 11 users looked for the message (searched manually) and found it in the inbox.
- Three users were confused whether he or she could click at an empty space in a row to open a message. In other web-based mail services, only sender's name or message subject could be clicked to open the message but Gmail designs the rows of the mailbox to be clickable and mail messages will be opened after users click anywhere in a row.

Comments and responses from Yahoo! Mail users:

- Six users looked for the message but could not find the message, and then they used search function and found the message in "Travel" folder.
- Two users looked for the message but could not find the message. Finally, they admitted that they could not complete the task.

- One user tried to sort the message list but could not find the right message, and then he used search function and found the message in “Travel” folder.

Comments and responses from the new prototype users:

- Seven users used search function to search for the message.
- Eight users searched the message manually.

The result of time-on-task study on task two was then analyzed using Mann-Whitney U Test to measure if there was a significant difference on the results between email services.

Comparison	Task 2: p value (2-tailed)
Gmail – Yahoo! Mail	0.005 *
Gmail – New Prototype	0.633
Yahoo! Mail – New Prototype	0.005 *

Table 4-28: Mann-Whitney U Test Significant Results from Task Two

Table 4-28 presents the results of the Mann-Whitney U Test of results from task two. Since the p value (two tailed) between Gmail and Yahoo! Mail, and Yahoo! Mail and the new prototype is < 0.05, the null hypothesis is rejected. There is a significant difference between the results of Gmail and Yahoo! Mail, and Yahoo! Mail and the new prototype. The median of the time-on-task results of Gmail and new prototype is lower than that of Yahoo! Mail. It an be inferred that the use of labels in Gmail and filters in the new prototype affect users’ performance on searching emails that are assigned to one or more categories. Most Gmail and new prototype users could find messages manually from the inbox. Yahoo! Mail users had to spend time searching manually in inbox first; then they either manually searched in each folder or entered the search keyword in the search box.

Results from Task Three

Task three was designed to study email conversational thread issue. The main focus was to measure users' results and responses to access (read) all the emails in a particular conversational thread. The task was: "Open each message that reply to the message 'Party on Friday night'."

The scenario for this task was there was a message with the subject "Party on Friday night" sent to the mailbox and there were three messages that replied to this original message. Users needed to read all the reply messages in order to understand the whole conversation. Gmail groups messages in the same conversational thread as one conversation so that users can see all the messages within one click. The new prototype also groups messages in the same thread together and also makes them more visible by not reducing emails in the thread into one row but displaying the messages together. Yahoo! Mail does not use any strategy for conversational thread. The reply messages are usually identified as "Re:" followed by the original message's subject. Table 4-29 presents descriptive statistics of results from task three.

User	Valid N	Mean	Median	Minimum	Maximum	SD
Gmail	14	16.21	15.50	5	30	7.485
Yahoo!	15	27.33	28.00	15	49	8.641
New P.	15	8.73	8.00	2	17	4.431

Table 4-29: Descriptive Statistics of Results from Task Three

The median of Gmail is lower than that of Yahoo! Mail, and the median of the new prototype is lower than that of Gmail. Two Yahoo! Mail users had to click on each message and go back to the inbox to click other messages while Gmail and the new prototype users could access every message in the thread in one click. However, there was one Gmail user that could not complete the task since he was familiar with the term "Re:" used in reply messages. He could not find this term in the Gmail inbox since Gmail groups all the reply messages together with the original message and

gives the thread the same name as the original message, which does not contain the term “Re:.” Every user of the new prototype with ease completed the task.

Comments and responses from Gmail users:

- 14 users clicked on the conversation right away.
- Three users mentioned that the grouped thread is not clear. It was hard to determine which message arrived first. The chronological order is not obvious to see.
- One user suggested the use of color to distinguish old message and new message in the same conversational thread.
- One user tried to find the term “Re” but failed because Gmail groups messages in the same conversation together and takes off the term “Re:.” He could not complete this task.

Comments and responses from Yahoo! Mail users:

- All users clicked the latest reply message, and then clicked back to inbox to open other messages. All of them understood the term “Re:”
- One user mentioned that he understood that the bold text indicated unread messages.
- One user was confused between bold and regular texts.

Comments and responses from the new prototype users:

- One user was confused when he saw the messages that were grouped together
- One user mentioned that he noticed the word “Re:” more than the arrow icon used to indicate the reply message.

The result of time-on-task study on task three was then analyzed using Mann-Whitney U Test to measure whether there was a significant difference on the results between the web-based email services.

Comparison	Task 3: p value (2-tailed)
Gmail – Yahoo! Mail	0.001 *
Gmail – New Prototype	0.004 *
Yahoo! Mail – New Prototype	0.000 *

Table 4-30: Mann-Whitney U Test Significant Results from Task Three

Table 4-30 presents the results of the Mann-Whitney U Test of results from task three. Since all the p values are lower than 0.05, there are differences between all of the tested email services. By comparing the medians of the time-on-task results, the new prototype users finished the task faster than Gmail users. And Gmail users finished this task faster than Yahoo! Mail users. It is obvious that conversational thread grouping improves users' performance on locating email in conversational threads. Not grouping messages into one row also improves visibility because users can see all messages grouped together.

Results from Task Four

Task four was designed for email prioritizing issues. The main focus was to measure users' results and responses to mark a flag on a particular message. The task was: "Mark the flag to messages: 'Important tax information' and 'Insurance information'."

Both messages that needed to be marked were very easy to find because they were new messages in the inbox. Users needed to mark a symbol, which was either a flag (Yahoo! Mail and the new prototype) or a star (for Gmail), to indicate that these two messages were important. Table 4-31 presents descriptive statistics of results from task four.

User	Valid N	Mean	Median	Minimum	Maximum	SD
Gmail	15	21.07	14.00	7	58	18.641
Yahoo!	14	28.64	26.00	11	58	14.563
New P.	15	18.53	16.00	10	45	9.242

Table 4-31: Descriptive Statistics of Results from Task Four

The median of results of Gmail is lower than that of Yahoo! Mail. The median of results of the new prototype is close to that of Gmail. Gmail provides a pale blue star image at the beginning of every row in a message list. Gmail users can click the star icon and the message will be marked automatically. The star image turns bright yellow when the message is marked (see Figure 3-5 and 3-6). Gmail also includes "Add star" option in the "More Actions" drop-down menu (see Figure 3-2). The new prototype provides almost exactly the same function as Gmail, but it also highlights the row of flagged messages with yellow color. Yahoo! Mail offers only the choice to mark a flag in the "Mark" drop-down menu. Moreover, Yahoo! Mail uses the term "Mark flag as follow up" (see Figure 3-14) which caused confusion to some users because they may have wanted to find out if there was a flag for something else. This issue caused one Yahoo! Mail user to not be able to finish the task.

Comments and responses from Gmail users:

- Three users mentioned that they did not know the meaning of "Star."
- Three users experienced difficulty locating a star icon. They mentioned that the icon was not obvious to see.
- One user suggested there should be a different color applied on the entire row of star messages.
- One user mentioned that the star is too easily removed.

Comments and responses from Yahoo! Mail users:

- 11 users were confused with the term "Mark flag for follow up."

Comments and responses from the new interface users:

- Five users used the dropdown menu to mark flag.
- Ten users clicked a flag icon to mark flag.

The result of time-on-task study on task four is then analyzed using Mann-Whitney U Test to measure if there is a significant difference between the results from Gmail and Yahoo! Mail.

Comparison	Task 4: p value (2-tailed)
Gmail – Yahoo! Mail	0.037 *
Gmail – New Prototype	0.350
Yahoo! Mail – New Prototype	0.034 *

Table 4-32: Mann-Whitney U Test Significant Results from Task Four

Table 4-32 presents the results of the Mann-Whitney U Test of results from task four. There is a significant difference at the 0.05 level in the results of Gmail and Yahoo! Mail, and Yahoo! Mail and the new prototype. Gmail users finished the task faster than Yahoo! Mail users. The new prototype users also completed the task faster than Yahoo! Mail users, which also means the new prototype users performed this task better than Yahoo! Mail users. Most Yahoo! Mail users were confused with the term “Mark flag for follow up” as stated in the previous paragraph. Gmail and the new prototype users completed the task quickly by clicking a star or flag icon from the inbox.

Results from Task Five

Task five was designed for email archiving and deleting issues. Main focus was to measure users’ results and responses when deleting a particular message. The task was: “Open the message ‘New products from IUPUI bookstore’ then delete this message.” Table 4-33 presents Descriptive Statistics of Results from Task Five.

User	Valid N	Mean	Median	Minimum	Maximum	SD
Gmail	11	22.55	17.00	9	61	14.306
Yahoo!	15	9.87	10.00	4	18	4.207
New P.	15	10.47	10.00	5	18	3.681

Table 4-33: Descriptive Statistics of Results from Task Five

The medians of the results for Yahoo! Mail and the new prototype are the same. The medians of Yahoo! Mail and the new prototype are lower than that of Gmail. Yahoo! Mail and the new prototype provide a delete button clearly in the message page (see Figure 3-22 and 3-28). Gmail does not provide a delete button but provides the "Move to trash" option in the "More actions" drop-down menu. This design may cause an issue with users that are familiar with using a delete button. This issue prevented four Gmail users from finishing the task.

Comments and responses from Gmail users:

- All users tried to find a delete button but Gmail doesn't provide delete button. All of them mentioned that there should be a delete button.
- Four users could not finish the task even though they see the command "Move to trash."
- Four users mentioned that they did not know the meaning of the command "Move to trash". They clicked it and finished the task.

Comments and responses from Yahoo! Mail users:

- All users could locate the delete button and finish the task with ease.

Comments and responses from the new prototype users:

- All users can locate the delete button and finish the task with ease.

The result of time-on-task study on task five is then analyzed using Mann-Whitney U Test to determine if there are significant differences between the results for the conditions.

Comparison	Task 5: p value (2-tailed)
Gmail – Yahoo! Mail	0.001 *
Gmail – New Prototype	0.002 *
Yahoo! Mail – New Prototype	0.661

Table 4-34: Mann-Whitney U Test Significant Results from Task Five

Table 4-34 presents the results of the Mann-Whitney U Test of results from task 5. There is a significant difference between the result of Gmail and Yahoo! Mail, and Gmail and the new prototype. Yahoo! Mail users and the new prototype users finished the task faster than Gmail users. As previously stated, many Gmail users had trouble finding the delete button and four of them could not finish the task.

The Use of Search Function in Time-On-Task Study

As stated in the research question section, one of the hypotheses is "The interface of the new prototype encourages users to use the search function more than the interface of Gmail and Yahoo! Mail." The design of the new prototype places the search box next to the group of buttons and menus while Gmail and Yahoo! Mail place the search box far away from the menus and message list. The number of users who used the search function in the time-on-task session was recorded and reported in Figure 4-4. Use of search function depended on how hard it was to locate messages. No Yahoo! Mail users used the search function in task one. Some Gmail and new prototype users started using the search function from the first task. In the second task, the amount of Yahoo! Mail users who used search dramatically increased to six people, but all of them tried to search manually before they tried the search function. This is the difference between Yahoo! Mail users and other users (Gmail and the new prototype users); most searches in Yahoo! Mail were conducted because users could not find a message while other users noticed the search box from the beginning and

started using the search function right away. Users that have experience using the search function tended to keep using it since they felt it was easier to find a message with the search function than to find a message manually.

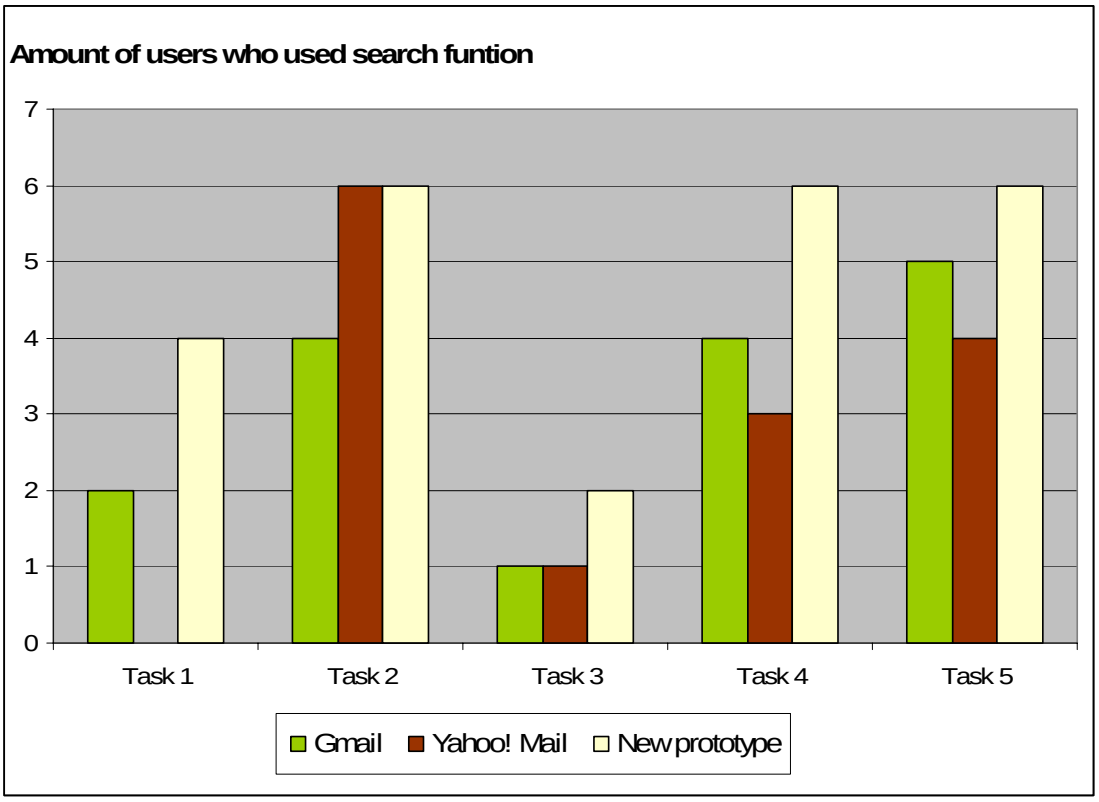

Figure 4-4: Amount of Users Who Used Search Function

The total number of searches was recorded for each group of users. A search percentage was then calculated by comparing the highest possible number of searches to the actual number of searches completed during the time-on-task study.

The search percentage calculation can be expressed as:

$$\text{Search Percentage} = \frac{\text{Total number of searches for a group}}{\text{Number of tasks x Number of users}}$$

$$= \text{Total number of searches for a group} / (5 \times 15)$$

Calculation results are shown in Figure 4-5. Gmail users used the search function for 21.3% of the tasks. Yahoo! Mail users used the search function for 18.7% pf the tasks. The new prototype users used the search function for 32.0% of the tasks, which is 10.7% more than the result from Gmail users and 13.3% more than the result

from Yahoo! Mail users. No statistical analysis was conducted on the search percentages.

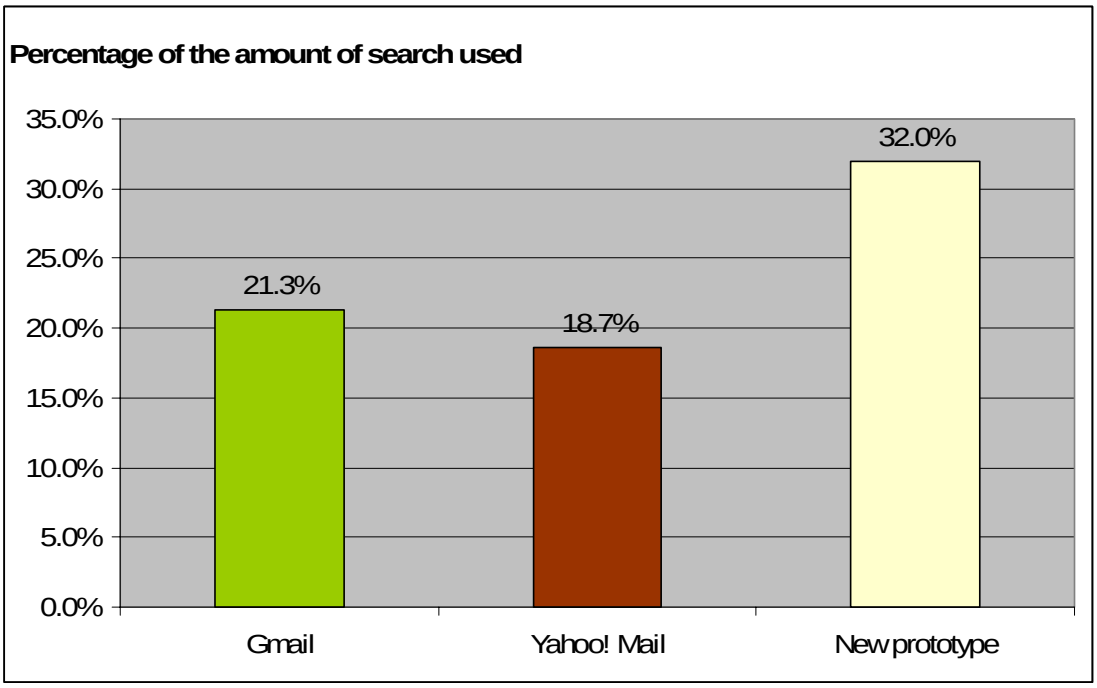

Figure 4-5: Percentage of the Amount of Search Used

CHAPTER FIVE: DISCUSSION

This section discusses the results reported in the previous section, beginning with the explanation of outcomes from the user studies on Gmail, Yahoo! Mail, and the new prototype. Then there is a discussion of the implications from the results on email overload and the hypotheses proposed in the research question.

Explanation of Outcomes

The comparison of Gmail and Yahoo! Mail provides significant results that support the development of the new web-based email prototype. There are both advantages and disadvantages of Gmail and Yahoo! Mail.

Gmail users performed well in the time-on-task study. It might be due to Gmail developers try to apply many new email features such as conversational thread grouping and the idea of label. However, the feedback on the aspect of interface design of Gmail was mainly negative. While giving Gmail capabilities to perform useful features, it is difficult for the Gmail developers to keep the interface as user-friendly as current web-based email services like Yahoo! Mail.

Yahoo! Mail interface was considered user-friendly by most of the Yahoo! Mail users. Buttons and menus are easy to understand. Users are familiar with the use of folder structure since it is the same as a computer's file structure. While Yahoo! Mail designers keep the interface easy to use, they miss the opportunity to apply some new useful features. Since Yahoo! Mail users in the real world are very broad, Yahoo! Mail designers cannot make many changes and adjustment in a short period of time. Gmail is still in beta version so that the Gmail system is more flexible for developers to apply and try new features.

The outcomes from Gmail and Yahoo! Mail studies were remarkable that Gmail users performed better than Yahoo! Mail users for three tasks; Yahoo! Mail received better feedback in the aspect of users' preferences. The explanation of this inconsistency is that performances and preferences are different. Users do not always prefer to use systems or applications that allow them to finish the task faster. There are many other factors that effect user' preferences, for example, emotional effect after perceiving the interface. One example of this kind of conflict is automated telephone system and human operator. Users may be able to finish the task (such as booking a hotel) faster by automated phone system but most of them may still prefer to talk with a human operator since they feel that talking with human is better than listening the machine. However, Gmail and Yahoo! Mail interfaces are not as different as automated phone system and human operator are. There were still some users who liked Gmail's interface (but less than those who did not like Gmail's interface). And there were other who did not like Yahoo! Mail interface. It is very complicated, yet challenging, to design the interface that suits most users' needs while providing useful features to support users to finish their tasks.

The new interface was designed based on the analysis of the results from user study of Gmail and Yahoo! Mail, including questionnaire, time-on-task study, and interview session. The positive and negative factors from the previous results are taken into the consideration of the design. New ideas were applied for some areas that could be improved. As a suggestion of a better web-based email interface, the new prototype was tested in the time-on-task study and users provided feedback on how they felt about the new interface. The new interface users performed well in the time-on-task study. The new prototype users finished the task faster than Gmail users on tasks three and five. Also, the new prototype users finished the task faster than

Yahoo! Mail users on tasks two, three, and four. There is no task that the new prototype users performed worse than Gmail or Yahoo! Mail users. In addition to the positive time-on-task results, many of the new prototype users liked its visual design and color scheme. Many of them mentioned that the interface was user-friendly and similar to existing web-based email services such as Yahoo! Mail and Hotmail. However, some users still criticized the use of color in the new interface as not appropriate or not professional. Moreover, there are some important issues that need to be resolved for the new prototype such as the lack of feedback message after the users use any command in the mail system. The new prototype has to be improved in many aspects to truly incorporate the suggestions on how the web-based email should be designed.

The email overload problem prevented users from managing email as efficiently as they wanted to. There are many aspects to be explained corresponding to the problem. The four hypotheses dealt with the design that supports 1) Email categorizing, 2) Email thread grouping, 3) Email searching, and 4) Email task management.

Email Categorizing

H1: Categorization using views allows users to manage email more efficiently than categorization using folders.

The time-on-task study compared the performances of email categorizing in task one and task two. In task on, users had to apply a new category to three specific emails. The result from task one indicated that there was no difference in the performance during the process of assigning the category to emails; even different email systems use different approaches to email categorizing. The difference in the terminology used (Folder, Label, and Filter) had no effect on the performance to

assign the category. However, in the second task, users had to locate an email in a specific category. Email systems with the categorization using views (Gmail and the new prototype) allow users to search an email faster than Yahoo! Mail which uses folders for email categorization. This finding supports the hypothesis that categorization using views allow users to manage email more efficiently than categorization using folders. Categorization using folders has a limitation that one message can be in only one folder at a time. When users wanted to find an email message in a folder, they needed to go to the right folder if they wanted to search the message manually. Unlike folder, the concept of view allows all emails to be viewed in the inbox while at the same time some emails can be grouped in one or more categories. The concept of view provides flexibility to assign email messages into one or more categories while all emails can be seen in the same place such as the Inbox.

Email Thread Grouping

H2: Grouping emails in the same conversational threads together allows users to locate emails in the same conversational thread faster than not grouping them together.

The time-on-task study compared the performance of email categorizing in task three. Users had to open and read all the reply messages that replied to a specific message. The result from task three indicated that users that tested email systems with the thread grouping feature (Gmail and the new prototype) performed the task faster than Yahoo! Mail users. In addition to the result, the new prototype users also performed the task faster than Gmail users. The conversational thread is one of the causes of the email overload problem when users do not use email for its original purpose, as an asynchronous communication tool. When email is used as a conversational tool, the conversational thread can be developed over a long period of

time and previous emails in the thread can be left out behind all other messages that had been sent during the time the thread was developed. Users can access all the emails in the same thread faster when those emails are grouped together, which supports the second hypothesis stated above. While Gmail grouped messages in the same thread in one row, the new prototype only grouped messages together and left those messages in many rows. This approach allows users to perform any email operation such as mark flag, apply filter, or delete on the individual message even when it is grouped in the conversational thread.

Email Searching

H3: The interface of the new prototype encourages users to use the search function more than the interface of Gmail and Yahoo! Mail.

From the result of the user profile questionnaire, only 31.1% of the users used search function in web-based email. Observation of users' search habits in the time-on-task study revealed there are two kinds of trigger or condition that made users use a search function. The first trigger was when users saw a search function and use it right away. The second trigger was when users could not find a message manually and then they used a search function to search the message. Because the later case consumed more time than the first case, the design of the new prototype attempted to place the search box in the area that was more visible to the users. The result of the time-on-task indicated that the percentage of the amount of search used from the new prototype users was higher than those of Gmail and Yahoo! Mail users. Moreover, the post-task questionnaire result indicated that 100% of users strongly agreed that the search box of the new interface was easily located. From the qualitative result, it can be inferred that the interface of the new prototype encourages users to use the search

function more than the interface of Gmail and Yahoo! Mail. The third hypothesis has been supported by this implication.

Email Task Management

H4: The note feature of the new prototype is more suitable to support users need for email task management than the calendar feature.

Task management is one of the activities that email users do with email. Additional activities like task management can cause email overload problems. Advanced task management features, such as calendar, consume users' time and mental workload and prevent them from managing emails efficiently. On the other hand, many users do not utilize the task management feature provided by the email services since it is not the feature that they are looking for. Many users commented that they need to use the email system for email only, not for daily planning. Regarding the user-profile questionnaire, users prefer a simple task management feature to an advanced one. The new concept of task management as a note for each message was applied in the new prototype. Instead of planning daily activities on a calendar, the note feature allows users to make notes about messages. The note feature provides many possibilities for use. For example, users can use the note feature as a draft before they reply to any message. Or users can take notes about activities related to message content, such as payment status for the electronic invoice. 53.3% of the new prototype users strongly agreed and 40% of them agreed that the note feature was useful. Most users mentioned that they wanted to use the note feature should it exist in their current email service. From the qualitative result of users' feedback, the hypothesis was supported that the note feature of the new prototype is more suitable for email task management than the calendar feature.

Implications

This study provides recommendations on how the web-based email can be designed to handle the email overload problem. The study also provided a methodological guideline to evaluate and compare web-based email services. There are many other electronic communications applications that users use for a wide range of activities such as other web portals, web applications, PDA applications, etc. This model of study can be adapted for the usability study of those applications. The complication of statistical data and qualitative data can be used to justify future data collection and budget decisions. The prototype design of this study offers a guide on how to develop the prototype based on qualitative data, quantitative data, and knowledge from the literature review.

CHAPTER SIX: CONCLUSION

The email overload problem occurs because users use email service in ways for which it is not designed. One cause of email overload is that there are too many emails in the mailbox, which is caused by email archiving when the storage is not full. Solutions for this issue include the good email categorization strategy and the utilization of a search function. Conversational threads in email also cause the overload problem. One solution for this issue is grouping emails in the same thread together. Task management is also a factor that causes email overload problem. Solution for this issue is providing simple task management feature like note-taking that is suitable for most email users.

Limitations

Due to the limitations of time and budget of this study, participants in this study were selected using a convenience sampling procedure. Participants representing email users in this study were 45 IUPUI undergraduate and graduate students. The range of email users in general is in fact much wider than the participants in this study. With a larger sample, more reliable statistical techniques could have been used to draw generalized results. Moreover, it would be valuable to compare more than two web-based email services to reveal more potential problems in the existing email services.

One other limitation is that the purposed dynamic prototype could not be fully developed in a short timeframe. Even though the developed prototype was highly functional, it sometimes could not responded to some commands from users. A complete user study result could not be collected from the partially functional prototype.

Last but not least, since email is a private activity, one which users consider to be for their own private communication use, it is difficult to design a study in which the researcher can observe users unobtrusively in the real life setting.

Future Research

A number of potential investigations present themselves. First, if there is not much limitation on time and budget, there should be more participants in the same study. A completely dynamic prototype should be used in the study.

A study of user behavior on using email in a prolonged period of time (such as three months) will reveal much valuable information such as email categorizing habits, email deleting and archiving habits, and the length of average conversational thread, etc.

Finally, the new prototype can be developed into a fully functional email service that serves real users on the Internet where the real usage statistics of email users can be analyzed. The study can also be expanded to incorporate the multicultural point of view on email usage and how users in difference cultures react to the same email interface.

Summary

The study addressed causes and results of email overload, and then measured the email user study data with qualitative and quantitative approaches. The data were then analyzed using various methods. Finally, the new prototype was developed to show how the web-based email can handle the email overload problem. The study was primarily concerned with 1) Email categorizing, 2) Email thread grouping, 3) Email searching, and 4) Email task management. The new prototype received satisfactory feedback from users in both features and designs.

REFERENCES

Balter, O. (2000). Keystroke level analysis of email message organization. In *Proceedings of the sigchi conference on human factors in computing systems* (pp. 105--112): ACM Press.

Bellotti, V., Dalal, B., Good, N., Flynn, P., Bobrow, D. G., & Ducheneaut, N. (2004). What a to-do: Studies of task management towards the design of a personal task list manager. In *Proceedings of the 2004 conference on human factors in computing systems* (pp. 735--742): ACM Press.

Bellotti, V., Ducheneaut, N., Howard, M., & Smith, I. (2003). Taking email to task: The design and evaluation of a task management centered email tool. In *Proceedings of the conference on human factors in computing systems* (pp. 345--352): ACM Press.

Boardman, R., & Sasse, M. A. (2004). "stuff goes into the computer and doesn't come out": A cross-tool study of personal information management. In *Proceedings of the 2004 conference on human factors in computing systems* (pp. 583--590): ACM Press.

Dabbish, L., Venolia, G., & Cadiz, J. J. (2003). Marked for deletion: An analysis of email data. In *Chi '03 extended abstracts on human factors in computing systms* (pp. 924--925): ACM Press.

Gwizdka, J. (2004). Email task management styles: The cleaners and the keepers. In *Extended abstracts of the 2004 conference on human factors and computing systems* (pp. 1235--1238): ACM Press.

Gender and ethnicity of students. (2003).*Indiana University Factbook*. Retrieved 11/30/04, 2004, from http://factbook.indiana.edu/fbook03/enrsex03.html

Gwizdka, J. (2002). Taskview: Design and evaluation of a task-based email interface. In *Proceedings of the 2002 conference of the centre for advanced studies on collaborative research* (pp. 4): IBM Press.

Gwizdka, J. (2001). Supporting prospective information in email. In *Chi '01 extended abstracts on human factors in computing systems* (pp. 135--136): ACM Press.

Gwizdka, J. (2000). Timely reminders: A case study of temporal guidance in pim and email tools usage. In *Chi '00 extended abstracts on human factors in computing systems* (pp. 163--164): ACM Press.

Jovicic, S. (2000). Role of memory in email management. In *Chi '00 extended abstracts on human factors in computing systems* (pp. 151--152): ACM Press.

Kerr, B., & Wilcox, E. (2004). Designing remail: Reinventing the email client through innovation and integration. In *Extended abstracts of the 2004 conference on human factors and computing systems* (pp. 837--852): ACM Press.

Lindgaard, G. (1994). *Usability testing and system evaluation* (1 ed.): Chapman & Hall.

Mackay, W. E. (1988). More than just a communication system: Diversity in the use of electronic mail. In *Proceedings of the 1988 acm conference on computer-supported cooperative work* (pp. 344--353): ACM Press.

McGrew, K. S. (2003, 01/15/04). Cattell-horn-carroll (chc) definition project. Retrieved 11/21/04, 2004, from http://www.iapsych.com/chcdef.htm

Millen, D. R. (1999). Remote usability evaluation: User participation in the design of a web-based email service. *SIGGROUP Bull., 20*(1), 40--45.

Pook, S., Lecolinet, E., Vaysseix, G., & Barillot, E. (2000). Context and interaction in zoomable user interfaces. In *Proceedings of the working conference on advanced visual interfaces* (pp. 227--231): ACM Press.

Rohall, S. L., Gruen, D., Moody, P., & Kellerman, S. (2001). *Email visualizations to aid communications*:IEEE.

Sheskin, D. J. (1997). *Handbook of parametric and nonparametric statistical procedures* (1 ed.): CRC Press.

Takkinen, J., & Shahmehri, N. (1998). Cafe: A conceptual model for managing information in electronic mail. In *Proceedings of the thirty-first annual hawaii international conference on system sciences-volume 5* (pp. 44): IEEE Computer Society.

Venolia, G. D., & Neustaedter, C. (2003). Understanding sequence and reply relationships within email conversations: A mixed-model visualization. In *Proceedings of the conference on human factors in computing systems* (pp. 361--368): ACM Press.

Whittaker, S., & Sidner, C. (1996). Email overload: Exploring personal information management of email. In *Proceedings of the sigchi conference on human factors in computing systems* (pp. 276--283): ACM Press.

Yiu, K., Baecker, R., Silver, N., & Long, B. (1997). A time-based interface for electronic mail and task management. In Proceedings of hci international '97 (Vol. 2, pp. 19-22).

APPENDICES

Appendix A: Pre-Test Questionnaire

For the Participants, actual online questionnaire can be accessed at http://www.chatreez.com/hci/questionnaire.php

FIRST NAME (only):_____ User Code: _____ Date: _____

General Information

1. Age □ 18-25 □ 26-35 □ 36-45 □ 56-65

2. Sex □ Male □ Female

3. Occupation □ Undergraduate student □ Graduate student □ University Faculty

Computer and Internet Experience

4. What kind of computer system do you use? □ Microsoft Windows □ Apple Macintosh

5. How long have you been using computers (years)? □ 1-3 □ 4-6 □ 7-9 □ 10+

6. How many hours each day do you use a computer? □ 1-3 □ 4-6 □ 7-9 □ 10+

7. How long have you been using the Internet (years)? □ 1-3 □ 4-6 □ 7-9 □ 10+

8. How many hours each day do you use the Internet? □ 1-3 □ 4-6 □ 7-9 □ 10+

General Email Experience

9. How long have you been using email (years)? □ 1-3 □ 4-6 □ 7-9 □ 10+

10. How many times each day do you check your email? □ 1-3 □ 4-6 □ 7-9 □ 10+

11. How long does it take you to access your mailbox each time (minutes)?

□ 1-5 □ 6-10 □ 10-15 □ 15-20 □ 20-25 □ 25-30 □ 30+

12. Do you use email client software? □ Yes □ No

13. If yes, please specify: □ Outlook □ Other _____

14. Do you use web-based email service? □ Yes □ No

15. If yes, please specify (1 or more):

□ IU webmail □ Gmail □ Hotmail □ Yahoo! Mail □ Other _____

16. How long have you been using your current web-based email (years)?

□ 1-3 □ 4-6 □ 7-9 □ 10+

17. Which area you use web-based email for?

□ Personal □ Study □ Work □ Other _____

Web-based email Experience

Please answer questions in this section from your current web-based email experience

Section 1 - Categorize

18. Do you create folder(s) to categorize email? □ Yes □ No

19. If yes, how many folders do you create?

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10+

20. What is your criterion to categorize message to folder? (One or more)

□ Message type (i.e., fwd mail, shopping)

□ Person or group (i.e., family, friends)

□ Time (i.e., last year)

□ Other (please specify)

21. Do you use filter function to automatically move a message to a particular folder?

□ Yes □ No

22. Do you prefer the feature that allows you to assign a mail message into more than one category? □ Yes □ No

Section two - Thread and reply

23. Would you like the mail service to group all the reply messages with the original message?

(All reply messages will be grouped with the original message, similar to web forum)

□ Yes □ No

24. Do you delete original text when you reply message? □ Yes □ No

25. Do you know the function of “Reply all”? □ Yes □ No

Section three - Prioritize email

26. What do you do to prioritize important email message?

□ Mark as flag, star

□ Mark as unread

□ Remember (Do nothing)

□ Other (please specify)

Section 4 - Archiving email

27. Do you have emails that are no longer needed in your mailbox? □ Yes □ No

28. If yes, why do you keep those emails? (Choose one or more)

□ Mailbox storage is not full/Email service offer large mail storage

□ To keep record in case of using any of those mails in the future

□ Other (please specify)

29. Would you like to have the function that you can set expiring date for each email message? (Expired email will be moved to trash folder) □ Yes □ No

Section 5 - Organizer/planner/schedule

30. Do you use planner/schedule feature provided in the email service? □ Yes □ No

31. Do you prefer to use advance planner such as calendar feature in the email service? □ Yes □ No

32. Do you prefer to use simple planner such as notepad feature in the email service? □ Yes □ No

33. Do you usually use search function to search email message? □ Yes □ No

34. If yes, why don't you use search function? (Choose one or more)

□ Search box is not obvious, so you don't notice it

□ You always find mail message manually

□ Your email activities are usually simple (read new mails, delete mails) so you don’t need to find or search previous email

□ Other (please specify)

Appendix B: Usability Test Script

For the observer to read to the subject

Hi, my name is Chatree Campiranon, and I am collecting data for my Thesis. I am developing the new prototype for web-based email service. Thank you for giving me your time to test the email service. I'd like to cover a few points and instructions with you before you begin this usability test of the web-based email service.

1. **Your role today is as web-based email user. You should be clear that you are NOT being tested, but rather the email service you will review is what is under examination.**
2. **Your input will greatly help me make a better decision as to the design of the new web-based email prototype.**
3. **The testing process will consist of three parts:**
   a) A pre-task questionnaire, which will provide some background about your experience as a computer user and email user.
   b) A series of 6 tasks, focusing on different area of web-based email activities. You will have approximately three minutes to complete each task. However, this should be more than enough time. In the event you go over the allotted time I will ask you to move on to the next task.
   c) A post-task interview, which will ask you a range of questions related to your experience with the email service you just reviewed.
4. **Regarding the Tasks:**
   a. You will be allowed to read each of the 6 tasks before you begin. This will allow you time to completely understand what each task is asking you to do.
   b. Please feel free to ask if anything is unclear. If once you begin and the task still seems unclear, you may ask whatever is needed.
   c. During the process of carrying out each task, I ask if you could speak aloud what you are thinking or feeling.
      i. In other words feel free to verbalize any problems, i.e., frustrations, disturbances, ambiguities, or unclearness in anything you see during the process.
      ii. You may also express any positive comments if you feel it is necessary.
      iii. You don't need to be excessive, but rather very natural in verbally expressing what you would normally keep in your head.
   d. Please, do not feel pressured as if you were under a time limitation to complete each task, but rather simply read the task and carry it out as quickly as possible.
5. **During the task period, I'll record the time for completing each task and take note on your comments and expression. There will be no audio or video recording at any time.**
6. **After you have completed the post-task questionnaire, you will be free to go.**
7. **I deeply appreciate your cooperation in the email service testing and will follow-up with a formal letter of thanks.**
8. **Are there any questions?**
9. **So, let's get started.**

Appendix C: Task Record/Log Sheet

For the observer

User number _____ **Date** _____

Service tested □ Gmail □ Yahoo! Mail □ New Prototype

		Notes
Task 1	Task Time: Min. & Sec.	
	Task completed: Yes or No	
	Comments on observed behavior.	
Task 2	Task Time: Min. & Sec.	
	Task completed: Yes or No	
	Comments on observed behavior.	
Task 3	Task Time: Min. & Sec.	
	Task completed: Yes or No	
	Comments on observed behavior.	
Task 4	Task Time: Min. & Sec.	
	Task completed: Yes or No	
	Comments on observed behavior.	
Task 5	Task Time: Min. & Sec.	
	Task completed: Yes or No	
	Comments on observed behavior.	

Appendix D: Task Sheet for Yahoo! Mail

For the Participants

User number _____ Date _____

TASK NO.	TASK DESCRIPTION
1	Move three most recent emails from the sender “Chatree Campiranon” into **new folder** named “From Chatree”
2	**Open** the message “Vacation plan” from the sender “Paula S”
3	**Open each message that reply to** the message “Party on Friday night”
4	**Mark the flag** to messages: “Important tax information” and “Insurance information”
5	**Open** the message “New products from IUPUI bookstore” then **delete** this message.

Appendix E: Task Sheet for Gmail

For the Participants

User number _____ Date _____

TASK NO.	TASK DESCRIPTION
1	**Label** three most recent emails from the sender "Chatree Campiranon" into **new label** named "From Chatree"
2	**Open** the message "Vacation plan" from the sender "Paula S"
3	**Open each message** that reply to the message "Party on Friday night"
4	**Mark the star** to messages: "Important tax information" and "Insurance information"
5	**Open** the message "New products from IUPUI bookstore" then **delete** this message.

Appendix F: Task Sheet for the New Prototype

For the Participants

User number _____ Date _____

TASK NO.	TASK DESCRIPTION
1	**Apply filter** to three most recent emails from the sender "Chatree Campiranon" into **new filter** named "From Chatree"
2	**Open** the message "Vacation plan" from the sender "Paula S"
3	**Open each message** that reply to the message "Party on Friday night"
4	**Mark the flag** to messages: "Important tax information" and "Insurance information"
5	**Open** the message "New products from IUPUI bookstore" then **delete** this message.

Appendix G: Post-Test Interview Session Form

For the observer to interview the subject

User number _____ Date _____

1. What was your immediate impression of the interface of this email service?
   Note:

2. What did you like the most and the least about this email service?
   Note:

3. How would you grade how easy it was to use – A, B, C, D, or F?
   Note:

4. Did you understand how to use the basic menus and buttons right away?
   Note:

5. What were the biggest problems you found on the previous test?
   Note:

6. Any comments on feature that you want to use on the web-based email service but doesn't exist?
   Note:

7. Could you explain your habit of using search function in web-based email?
   Note:

8. Could you explain your habit of deleting mail messages?
   Note:

9. Could you explain your habit of using planner/schedule function in web-based email? *Note:*

Appendix H: Post-Task Questionnaire

User Code: _____ **Date:** _____

Site: **CMail**

Please answer the following questions based on your experience using the web-based email.
SA = Strongly Agree, A = Agree, N = Neither, D = Disagree, SD = Strongly Disagree

Questions related to general design of the Web site

11.	The amount of text and graphics on the Web site is appropriate.	SA	A	N	D	SD
12.	The use of color is appropriate.	SA	A	N	D	SD
13.	The text and graphics are presented in a visually aesthetic manner.	SA	A	N	D	SD
14.	The terminology is understandable throughout the site.	SA	A	N	D	SD
15.	The buttons and menus are easily understood.	SA	A	N	D	SD
16.	The buttons and menus are easily located	SA	A	N	D	SD
17.	The design is consistent through out the site.	SA	A	N	D	SD
18.	The design provides information on where you are on the Web site.	SA	A	N	D	SD
19.	Overall, pages are quick to load.	SA	A	N	D	SD
20.	Overall, the design of the Web site is attractive.	SA	A	N	D	SD

Questions related to specific designs and features of the Web site

12.	The view/filter is easy to use.	SA	A	N	D	SD
13.	The categorizing function is efficient. (It is easy to manage and locate messages in categories.)	SA	A	N	D	SD
14.	It is easy to view a particular type of messages. (For example, new messages, flagged/starred messages)	SA	A	N	D	SD
15.	It is easy to read/locate all the messages in the same conversational thread. (Original message and Re: messages)	SA	A	N	D	SD
16.	It is easy to mark flag on email messages.	SA	A	N	D	SD
17.	It is easy to mark email messages as unread.	SA	A	N	D	SD
18.	The search box is easily located.	SA	A	N	D	SD
19.	The archive feature is useful.	SA	A	N	D	SD
20.	The archive feature is easy to use.	SA	A	N	D	SD
21.	The note feature is useful.	SA	A	N	D	SD
22.	The note feature is easy to use.	SA	A	N	D	SD

Overall impressions of the Web site

On a scale of 1 to 10, 1 being the worst, and 10 being the best, how would you rate this site based on what you have seen today? **1 2 3 4 5 6 7 8 9 10**

Comments and suggestions

*Factors that **negatively** influenced this Web site's rating were:*

*Factors that **positively** influenced this Web site's rating were:*

Any other comments and suggestions that that you feel will help us evaluate the usability and develop the better web-based email service.

VITA

Chatree Campiranon

chatreez@yahoo.com
http://www.chatreez.com
(317) 332-7191
3482 Woodfront Pl.
Indianapolis, IN, 46222 USA

Education

Master of Science in Human-Computer Interaction, Expected May 2005
School of Informatics, Indiana University Purdue University at Indianapolis (IUPUI)
Thesis: Web-based Email Management for Email Overload
Advisor: Anthony Faiola

- Web-based Email Management for Email Overload is the study that focused on designing web-based email prototype to handle email overload problem.

Bachelor of Engineering in Computer Engineering, March 2002
Kasetsart University, Thailand
Project: Music Recognition

- Music Recognition is an application that interprets incoming sound into frequencies using Fast Fourier Transform technique. Then frequencies are converts into musical notes as a MIDI file and musical score.

Research Interests

- Usability design for web applications
- Usability design for computer music applications

Experiences

Web programmer, Department of Mathematics, IUPUI, Indianapolis, IN
Jan 2005 – Apr 2005

- Developed web-based applications using PHP, MySQL, and JavaScript for Mathematics department

Teaching Assistant, School of Engineering, Kasetsart University, Thailand
May 2000 – March 2002

- Developed log monitoring software for university's main web server
- Graded homework, assignments, and exams