Information Horizons of Taiwanese Graduate Students

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ABSTRACT

The information horizon is an imaginary field that users position their information sources according to their perceived importance. Previous research investigated Internet users' information horizons and pointed out that the information source accessibility and quality play an important role in the information horizons and orient people's information seeking behavior. This study examined how the perceived source accessibility and perceived source quality influence Taiwanese graduate students positioning their information sources in their information horizons. The study aims to examine the influence of perceived source accessibility and quality on students' information horizons, and to examine the differences of information horizons among students from different disciplines. Two methods were employed to collect data: the information horizon map drawn by Taiwanese graduate students and interviews with those students. Nine Taiwanese graduate students at University of Wisconsin-Madison were recruited. Results showed that all students tend to include more information sources in the center (most preferable) than the peripheral zone (least preferable) on their information horizon map. However, students from humanities and social sciences included more information sources in their information horizons than students from sciences did. Contrary to previous information horizon research on everyday information seeking behavior, this study showed that despite the fact that graduate students from all disciplines preferred information sources with high accessibility, they also considered quality as an important factor. Future research may focus on a specific concept of information horizons, such as social networks, and include different groups of International students and compare with their American counterparts to learn more about students' information horizons under research contexts among disciplines and cultures.

Keywords

Information Horizon, Information Behavior, Source Accessibility, Source Quality, Taiwan

1. INTRODUCTION

Articles about information seeking behavior constitute a relatively large portion of Library and Information Science research. With the rapid development of the Internet, researchers have been investigating the influence of the Internet on users' information seeking behavior as well as the principle of least effort in their information behavior. In recent years, more attention has been paid to contextual, situational, or role variables (e.g. students, patients, etc.) than usual demographic variables (e.g. age, gender, etc.), and these studies have a common concern with sources and channels – typically interpersonal channels [2]. However, while humans' information behavior may be easy to learn, it is indeed a rather intricate and perplexing issue. Information behavior can be influenced by a variety of factors. Not only demographic variables but also contextual, situational, and role variables are critical for analyzing and understanding humans' information behavior. So

studies which consider both demographic and role variables may be even more valuable.

In a perspectivist viewpoint, spatial factors in information seeking are perceived by users and thus are highly subjective and depend on contexts and situations [15]. Sonnenwald developed a theoretical framework of information horizons to depict the concepts of contexts, situations, and social networks in humans' information behavior [19]. She defined information horizon as how information seekers perceive the usefulness of information sources. In an information horizon map, users positioned information sources according to their perceived importance in various contexts. In this vein, Savolainen and Kari investigated Internet users' information horizons in a non-work role situation and pointed out that information seeking is oriented by the information source horizons [14]. They found that the accessibility and quality of information sources/channels play a particularly important role. Therefore, information horizons may not only show the contexts, situations, and networks in users' information behavior, but also exhibit users' perceived information accessibility and quality. Thus studies on information horizons may expand the knowledge of users' information need, information seeking and information use as a whole.

Sonnenwald claimed that information horizons research have influenced studies on information needs of high school students, graduate and undergraduate students, older adults, and professionals [20]. Nevertheless, very few studies have been actually based on the theoretical framework of information horizons, and what studies have been conducted are mainly about information seeking behavior of non-work purposes [8, 14, 16]. Although recent studies by Huvila on information horizons moved the focus on work roles, no article investigated graduate students' information behavior in terms of their information horizons. In addition, articles investigating graduate students information behavior in terms of spatial factors did not focus on their information horizons [4, 5]. Regarding the lack of knowledge in graduate students' information horizons, it would contribute to the field if we explore more about graduate students' information horizons and integrate their information needs, information seeking and information use – in terms of information source selection – into this framework. Given the researcher's background as a Taiwanese international student, she believes that conducting an exploratory study on a group of international students that she is most familiar with would be a good start.

Therefore, this study examined how the perceived source accessibility and perceived source quality may influence Taiwanese graduate students positioning their information sources in their information horizons. The purpose of this study included: 1. to examine the influence of perceived source accessibility on students' information horizons; 2. to examine the influence of perceived source quality on students' information horizons; and 3. to examine the differences of information horizons among students from different disciplines. Three research questions were

raised: First, what do Taiwanese graduate students include in their information horizons? Second, how do they determine what to include in their information horizons in terms of perceived source accessibility and quality? And third, how do the information horizons differ among Taiwanese graduate students' in different disciplines? The ultimate purpose of this research was to get a better understanding about the information horizons of Taiwanese graduate students in research context so that libraries may provide more suitable services to assist graduate students in doing their research. Specifically, exploring students' most preferred information sources and channels may provide some basic guidance for collection development or collection management decisions. Exploring what information sources or channels were least preferred by students may provide implications on library services promotion or information literacy programs.

2. LITERAURE REVIEW

Information behavior studies related to spatial factors can be categorized into three approaches according to the levels of abstraction: the objectifying approach, the realistic-pragmatic approach, and the perspectivist approach [15]. Examining users' information horizons is exploring information behavior with a perspectivist approach. Briefly introducing these different approaches may help us picture where information horizons are situated in information behavior research.

In the article "Spatial Factors as Contextual Qualifiers of Information Seeking, "Savolainen described and discussed the three approaches [15]. Traditionally, researchers use the objectifying approach to discuss spatial factors in information behavior in a physical sense, and view spatial factors as something discrete and entity-like which may constrain information seeking. In a realistic-pragmatic approach, information seekers may rethink the role of spatial factors and redefine their source preferences by abandoning time consuming visits to a remote library and search for information on the Internet instead. This approach is derived mainly from the revised information pathways by Johnson [7], Pettigrew's information grounds [12], and Chatman [3]'s small world theory. Finally, the perspectivist approach also shares the same proposition with the realistic-pragmatic approach that spatial factors not only constrain information seeking, but also enable it. However, the perspectivist approach focuses more on the subjective and situation-bound interpretation of spatial factors. The theory of information horizon mainly constitutes the perspective approach in information seeking research. This perspective approach provides a viewpoint for examining how people subjectively assess the significance of information sources and spatially construct their information horizons.

Diane Sonnenwald proposed the concept of information horizon and defined it as a map user positions information sources according to their perceived importance in various contexts [15]. This concept of information horizon provides the analysis of source preferences with a conceptual framework [14]. Despite proposing a theoretical framework, Diane Sonnenwald also provides a basic guideline for the research design of information horizons [20]. She points out that the purpose for studying information horizons is to examine when and why people access/ not access individuals or other information resources, to examine relationships among information resources, and to examine the proactive nature of information seeking process. The methods usually include semi-structured interviews with a critical incident interview technique and a map-drawing technique.

Empirical studies based on the theoretical framework of information horizons are mainly about the daily life of people and the non-work purposes. Several articles follow this semi-structured interview method, and some adapt the critical incident technique to investigate people's information seeking behavior. For example, Savolainen and Kari conducted a research study on information seeking by Internet users in the context of self-development [14]. They asked users to place the information sources in three zones on the map of information horizons according to their preferences. The most preferred sources were placed in Zone 1, while the least preferred sources were placed in Zone 3. In their study, the perceived source quality was given less attention in Zone 1, and the perceived accessibility, as well as quality, were weighed equally in Zone 2. In Zone 3, the information selection criteria mainly focused on the perceived source quality, and the assessments were easily affected by the negative experiences. They revised the definition of information horizon proposed by Sonnenwald, and defined it as "an imaginary field, which opens before the 'mind's eyes' of the onlooker – information seeker" [14]. Broadly speaking, these horizons can be defined as a perceived information environment. However, Huvila shifts the discussion on information horizons to work roles. Based on this conceptual framework, he discussed the work and work roles through a task-oriented approach [4]. Following his perspective, this current study looks into information horizons by viewing students and their coursework-related projects as work roles and tasks. In another study, instead of employing user-drawn information horizon maps, Huvila introduces an "analytical information horizon maps (AHIM)" and further develops a new method to approach users' information horizons [5]. The information horizon maps are drawn by the researcher according to the data collected from the interviews.

Other related studies on students' information behavior in terms of spatial factors might not be based on the theoretical framework of information horizons. There is indeed very little known about the information horizons of undergraduate or graduate students. For instance, Lee examined the students' interactions with information environment and how the structure of the information environment affected students' information seeking behavior [10]. Her study provided linkage among information seeking, information organization, and collection development. However, although Lee utilized a similar concept of presenting her interview findings on a map with immediate space, adjacent space, and outside space to show an information space for college students, her study is conducted in a more pragmatic approach with physical spatial factors [10]. Based on this pragmatic approach, this current study viewed the information space in a perspective view and tried to explore the information horizons of graduate students. Based on Lee's information space [10], Tsai investigated the citing behavior of Library and Information Science graduate students in National Taiwan University and found a similar information space which include online resources and personal collection in the immediate space, interpersonal channels and nearby libraries in the adjacent space, and interlibrary loan services, other libraries and bookstores in the outside space [21].

In addition, with the increasing international student population in the United States, there are articles exploring topics on academic library services and multicultural communities; however, fewer articles focus on the international students and study their

information needs and information seeking behavior [11], let alone the information horizons of a certain group of international students. Previous research shows that some library services may be new to international students and they may encounter linguistic, cultural, and technological barriers with their library use, which may also depend on their previous library experiences [11, 18]. Therefore, this current study examines the information horizons of Taiwanese graduate students studying in the United States in order to delve into and understand the information behavior of this specific group of international students.

3. THEORETICAL FRAMEWORK

The theoretical framework of information horizons proposed by Sonnenwald in 1999 was based on empirical studies of information behavior from various settings, specifically, Kuhlthau [9]'s information seeking model, Wilson [22]'s general model of human information behavior, as well as Belkin [1]'s and Ingwersen [6]'s studies [19]. Rather than providing specific factors for predicting certain changes in information seeking behavior, Sonnenwald believed that understanding information behavior as a process is more important, and examining the role of three fundamental concepts – context, situations, and social networks – in the theoretical framework of information horizons helps us explore information behavior as a process. In the framework of information horizons, contexts are multi-dimensional and can be described by attributes including place, time, goals, tasks, systems, situations, processes, organizations, and types of participants. Additionally, a flow of situations constitute a context. A situation may be characterized as a set of related activities, or a set of related stories that occur over time; however, situations within any given context are not necessarily linearly-ordered discrete events. Social networks refer to communication among individuals, in particular, patterns of connection and resonance interaction. Social networks help construct and are constructed by situations and contexts. This theoretical framework contains five propositions that describe the relationships of the three concepts stated above [19, p.181-188]:

- Human information behavior is shaped by and shapes individuals, social networks, situations, and contexts.

- Individuals or systems within a particular situation and context may perceive, reflect, and/or evaluate change in others, self, and/or their environment.

- Within a context and situation is an "information horizon" in which we can act.

- Human information seeking behavior may, ideally, be viewed as collaboration among an individual and information resources.

- Because information horizons consist of a variety of information resources, many of which have some knowledge of each other, information horizons may be conceptualized as densely populated spaces.

The information horizons provide a theoretical basis by proposing three concepts and five propositions for an evolving framework of information exploration, seeking, filtering, use, and dissemination. Additionally, this framework of Information horizons was built on previous research in information studies, communication and psychology [19]. Although this framework did not indicate how to design effective strategies for enhancing information seeking, it conceptualized the three fundamental concepts to describe information behavior, incorporates cognitive, social, and system

perspective, and aims at providing implications for system design [19].

However, while emphasizing the importance of social networks, Sonnenwald did not include information resources in the definition of the three fundamental concepts – contexts, situations, or social networks. It is reasonable to emphasize social networks in information horizons, but the information resources seem to play one of the critical roles in the information horizons, so that she mentions information resources in two of the five propositions. Instead of limiting the third concept to social networks which refer to individual members within situations and contexts, the third concept might be modified as network so that we can incorporate the information resources in this concept. Therefore, this study focused on three concepts – contexts, situations, and networks (rather than the narrowly defined "social network"). Moreover, based on previous research, Savolainen and Kari investigated Internet users' information horizons and pointed out that the information source accessibility and quality play an important role in the information source horizons and orient people's information seeking behavior [14]. This study tried to extract different elements that constitute the perceived information source accessibility and quality and explored how the two factors affect students' positioning of information sources on their horizon maps.

As for the methodology, Diane Sonnenwald provided a basic guideline for the research design of information horizons [20]. She pointed out that to learn how users position their information resources the methods usually include semi-structured interviews with a critical incident interview technique and a map-drawing technique. The map of information horizon which shows all information resources, including people, provides graphical articulation of the information horizon in a particular context. And the interview provides verbal articulation of the information horizon in that context. These methods not only help to describe the information resources used, but also explain their importance and role in the information seeking process.

However, most empirical studies based on this framework do not include a map drawing technique. One of the reasons might be it is difficult for subjects to include all the channels they used in a certain context or situation. Furthermore, as Sonnenwald mentioned, we should understand information behavior as a process and view information selection within those complex contexts as a dynamic process. Therefore, it might be difficult to approach such complex issues with a single map. Map drawing technique could give us a clearer picture of what information horizons are about. Nevertheless, there are still issues whether or not we can approach such complicated information behavior through a static map. An alternative way to employ a map drawing technique was a new methodology by Huvila. Huvila discussed the drawbacks of the original map drawing by Sonnenwald and proposed an analytical information horizon maps (AIHM) [5]. He believes that it would be more beneficial to draw a map from the interview records by the researcher rather than ask the participants to draw a map without interviewing them. Through this way, the researcher can structure and analyze typical information behaviors better. However, information horizon maps derived from this method would be totally interpreted by the researcher and thus might not actually explore the initial inquiry of learning how users position the information sources on their maps.

In order to gain a better understanding from the users' perspective, this study employed both interviews and map-drawings to examine the information horizons of Taiwanese graduate students in research contexts. Specifically, the focus of this study was on the research-related task situations in which students use or not use certain resources, and on students' information source networks in terms of their information needs and information seeking behavior.

4. METHODS

4.1 Data Collection

The study employed two methods for data collection: the information horizon map drawn by Taiwanese graduate students and semi-structured interviews with those students. The former may provide a clear picture about the information horizons of the students, while the latter may provide rich data for examples and explanations about how they position information sources on the maps. Additionally, this triangulation may increase the validity of this research.

There are approximately 150 Taiwanese graduate students at UW-Madison. The study recruited Taiwanese graduate students at UW-Madison through the mailing list of the UW-Madison Student Association of Taiwan (UWSAT). A consent form addressing the purpose and design as well as confidentiality was given to the participant when recruiting. For the exploratory nature of qualitative study, smaller sample size is required to obtain an in-depth understanding of certain phenomena, and thus this study recruited nine volunteers to participate. A purposive sampling was employed to balance the demographics of the sample, i.e., graduate students from humanities, social sciences, and hard sciences were equally sampled.

Nine Taiwanese graduate students volunteered to participate in this study. Four are master's students and five are doctoral students. Their age ranged from 25 to 33. Among which, three students are from each discipline, i.e. humanities, social sciences and hard sciences. Their majors include: English, music, linguistics, educational psychology, counseling psychology, consumer science, electrical and computer engineering, mechanical engineering, and civil and environmental engineering. The number of years they have been to the United States ranged from 1 to 5 (See Table 1).

Table 1. The demographic characteristics of the participants

Participant	Gender	Master's/ Doctoral	Discipline	Number of Years Studying in the U.S.	Task
Hannah	F	D	Humanities	4	Dissertation
Hank	M	D	Humanities	2	Thesis
Helen	F	M	Humanities	2	Final project
Sadie	F	M	Social Sciences	2	Final project
Selena	F	M	Social Sciences	1	Final project
Sandra	F	M	Social Sciences	1	Final project
Charles	M	D	Hard Sciences	5	Dissertation
Chris	M	D	Hard Sciences	1	Research project
Craig	M	D	Hard Sciences	5	Lab project

Table 1 also shows the tasks in research contexts that participant recalled in the interviews. Despite two students who have been studying in their current programs for 4 or 5 years recalled their dissertation, other students mainly recalled their final projects or lab projects as the research contexts. These specific tasks provided a basis of students' information horizons and determined their information needs. According to Sonnenwald, the doctoral dissertation task could be a situation and the department, discipline, state of art, etc. could be contexts [19]. Therefore, these tasks graduate students mentioned can be viewed as the situations while their discipline and level of degree can be viewed as the contexts in the information horizons. The networks of the information horizons in the findings would be how the information sources and channels related to one another. The nodes of the networks would be those information sources and channels, including the document types graduate students used, the people they consulted, and the places or ways they accessed the information sources.

In the semi-structured interview, a critical incident technique was employed to help graduate students recall their information needs and information source selection experiences. Participants were asked to recall the process of their research projects or theses/ dissertations in terms of what information sources they use and through what channels they access these resources, especially what are their information source preferences for their research related tasks. Participants were then asked to draw an information horizon map showing what information sources they use and through what channels they access these resources for course related tasks (e.g. doing a final project or paper, writing thesis or dissertation, etc.). They positioned these information sources in three given zones according to their preference (See Appendices 11.1). Afterwards, they were asked to explain their rationales, how important each resource or channel is to them when doing those tasks, and provide examples of situations they would access/use each resource. Additionally, they were asked to describe if there is anyone or any information source that lead them to other people or information sources. Each individual interview (including map drawing) ranged from 30 minutes to an hour.

Although Taiwanese graduate students studying at UW-Madison read English, it would be much easier for them to read their native language. Therefore, the researcher translated the instruction for map drawing and the interview guide from English to traditional

Chinese. In order to maintain the validity of this study, the researcher asked another Mandarin-speaking graduate student with high proficiency in English to look at both versions of the instrument and make sure the Chinese version were similarly translated. Please see appendices 11.1 for the instrument (English version).

4.2 Data Analysis

The interview was audio recorded and then transcribed for analysis. Pseudonyms were assigned to every participant in order to maintain confidentiality. The researcher analyzed the transcripts by coding related concepts in the transcripts into perceived accessibility and perceived quality to provide possible explanations of the students' information horizons. NVivo 8 was used as an analysis tool. Data collected from the interview transcripts are analyzed in descriptive, topic, and analytical levels. According to Richards [13], descriptive coding which informs the attributes of cases, e.g. person's gender, may also occur in quantitative studies. Topic coding merely allocates passages to topics which involves little interpretation. Analytical coding requires interpretation from descriptive and topic coding. The researcher conducted descriptive coding with the casebook in NVivo to provide the background information of participants and also conducted some topic coding to provide information sources/ channels mentioned by participants. Furthermore, the researcher also conducted analytical coding with tree nodes and matrix queries in NVivo, based on the research questions to provide possible explanations for the information source positioning of Taiwanese graduate students. For example, the statements related to advisors, colleagues, or friends were separately labeled as child nodes and were placed under the parent node of interpersonal channels. A code book is developed through the process of data analysis stated above. Specifically, following the five propositions in the information horizons, the researcher analyzed the background of individual as well as the situations and networks mentioned by the participant to see how they shape individuals' information behavior. The researcher analyzed how individual perceive, reflect, and/or evaluate change in others, self, and/or their environment by examining their rationale about access or not access/ use or not use certain information sources.

Data collected from the maps was analyzed by descriptive statistics adopted by Savolainen and Kari and was then further analyzed by comparing the results among different disciplines to see the similarities and differences [14]. In Savolainen and Kari's study, they calculated the number of sources/channels in each zone. They also weighted sources and channels by multiplying a source/ channel by 3 in Zone1, 2 in Zone 2, 1 in Zone 3, to see the weighted scores of each sources or channels. The researcher followed this analytical method and examined the distribution of types of information sources in the given three zones, and then analyzed the similarities and differences among disciplines.

5. RESULTS

5.1 Information Sources on the Information Horizon Maps

According to the results of this study, nine participants included 133 information sources or channels on their information horizon maps. Among which, 54 sources are in Zone 1, 46 sources are in Zone 2, and 33 sources are in Zone 3 (Table 2). In order not to inflate the number of different sources or distort the result of the source distribution in the three zones, sources or channels that mentioned several times were only counted once, and thus derived 114 different sources were derived from the maps. Overall, humanities students listed the most sources while hard science students listed the least (See Appendices 11.2). All students listed the least number of sources in Zone 3. Moreover, the patterns of the distribution of the sources in the three zones for social science and hard science students were similar. The more central the zone is, the larger the number of sources is.

Table 2. Distribution of sources/channels in different zones and disciplines

Number of Sources/ Channels	Humanities	Social Sciences	Hard Sciences	Total
Zone 1	17	21	15	53
Zone 2	22	16	8	46
Zone 3	16	13	4	33
Total	55	50	28	133

The researcher listed all information sources/ channels mentioned by graduate students in zone 1 to zone 3 (Table 3 to 5 shows the sources mentioned by graduate students in zone 1 to 3 accordingly), and categorized information sources/ channels into Internet, personal collections, interpersonal channels, library collections, media, lab resources, bookstores, other libraries/public libraries, and bibliography. Specific information sources under each category were listed as what participants wrote on the maps.

Table 3. Research information sources in zone 1[1]

Discipline	Humanities	Social Sciences	Hard Sciences
Source Type	Internet E-resource (MLA), Library online catalog, [Document delivery services], Department library website links, Grove online dictionary, Amazon Personal collections Personal collection Syllabus Interpersonal channels	Internet Databases (3), Library online catalog (2), Google (2), Open Access Journals, Reports from research institutes, Google Scholar (conference, working paper, journal articles), Government publications, [Document delivery services] Interpersonal channels	Internet Conference proceedings (2), Google, Google Scholar (2), Databases (3) (IEEE, ACM, Web of Science), Document delivery services Interpersonal channels Advisor (2), Lab cooperative partner (from other compan

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Discipline	Humanities	Social Sciences	Hard Sciences
	Advisor, Professors, Friends <u>Library collections</u> Journals (Articles), Theses, Books, Audio CD, Library reference collections, Scores from school	Professors (2) <u>Personal collections</u> <u>Library collections</u> E-journals, E-books, Books, Articles <u>Media</u> TV, News	y) <u>Lab resources</u> Theses, Instruments <u>Library collections</u> Journals

Table 4. Research information sources in zone 2[2]

Discipline	Humanities	Social Sciences	Hard Sciences
Source Type	<u>Internet</u> Google (review, thesis, score analysis), Databases (2), Wiki (not really reliable), Academic society website (need permission), <u>Personal collections</u> Scores, Pamphlets from Audio CD <u>Interpersonal channels</u> Taiwanese Classmates (research area), Classmates, Librarians, Master class feature artists, Studio class peer review, Audio materials from classmates <u>Library collections</u>	<u>Media</u> TV programs <u>Interpersonal channels</u> Lab colleagues (suggestions, information), Friends, Professor, Classroom peers (2) <u>Library collections</u> Reference books (2) (Dictionaries and others), Books (2) <u>Internet</u> Wiki, Amazon, Online Catalog, Document delivery services, Online News <u>Personal Collections</u>	<u>Internet</u> Google <u>Interpersonal channels</u> Classmates <u>Library collections</u> Journals (2), Textbooks, Books (2) <u>Lab resources</u> Software

Discipline	Humanities	Social Sciences	Hard Sciences
	Printed journal, Books, Interlibrary loan (ILL) <u>Media</u> History channel (discovery), Movies, TV series, Radio programs <u>Bookstore</u> (Bookman, Eslite bookstores)		

Table 5. Research information sources in zone 3[3]

Discipline	Humanities	Social Sciences	Hard Sciences
Source Type	Internet Google Library collections Journals, Magazines (2), Other articles, Bibliography in books Bookstores Bookstore, Buy scores Other libraries, Public libraries Interpersonal channels Friends (2), Classmates, E-mail professors for resources, Writing center instructors	Library collections Print journals, Books (2), Theses, Magazines, Microfilms Interpersonal channels Friends (2), Family, Writing center instructors Media Radio programs, Newspapers, TV News	Library collections Theses, Books Interpersonal channels Advisor, Colleagues

Weighting each source/ channel by multiplying the number of informants mentioned by 3 in zone 1, 2 in zone 2, 1 in zone 3 helps us see students' preferences. Table 6 to Table 8 shows the weighted scores in each zone. Tables 9 to 11 show the weighted scores of research information resources mentioned by students from each discipline. All of the graduate students preferred sources through the Internet and tend to position most information sources in zone 1 and zone 2. However, graduate students from different disciplines have different preference for positioning

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different sources in each zone. Compared to humanities and social science graduate students, hard science students tend to use fewer sources in each zone mainly through the Internet, interpersonal channels, lab resources, and library collections. On the other hand, humanities and social science students tend to use a variety of sources through the Internet, interpersonal channels, personal collections, library, and so on. Nevertheless, humanities students uniquely mentioned purchasing books or other research materials while social science students mentioned getting research ideas through the media.

Table 6. Weighted scores of research information sources in zone 1

Source Type	Humanities	Social Sciences	Hard Sciences	Total
Internet	18	39	27	84
Library collections	18	12	3	33
Interpersonal channels	9	6	9	24
Personal collections	6	3	N/A	9
Media	N/A	6	N/A	6
Lab resources	N/A	N/A	3	3

Table 7. Weighted scores of research information sources in zone 2

Source Type	Humanities	Social Sciences	Hard Sciences	Total
Interpersonal channels	12	10	2	24
Library collections	6	8	10	24
Internet	10	10	2	22
Media	8	2	N/A	8
Personal collections	4	2	N/A	6
Bookstores	2	N/A	N/A	2
Bibliography	2	N/A	N/A	2
Lab resources	N/A	N/A	2	2

Table 8. Weighted scores of research information sources in zone 3

Source Type	Humanities	Social Sciences	Hard Sciences	Total
Library collections	4	6	2	12
Interpersonal channels	5	4	2	11
Media	N/A	3	N/A	3

Source Type	Humanities	Social Sciences	Hard Sciences	Total
Bookstores	3	N/A	N/A	3
Other libraries/Public libraries	2	N/A	N/A	2
Internet	1	N/A	N/A	1
Bibliography	1	N/A	N/A	1

Table 9. Weighted scores of research information sources mentioned by humanities students

Source Type	Zone 1	Zone 2	Zone 3	Total
Internet	18	10	1	29
Library collections	18	6	4	28
Interpersonal channels	9	12	5	26
Personal collections	6	4	N/A	10
Media	N/A	8	N/A	8
Bookstores	N/A	2	3	5
Bibliography	N/A	2	1	3
Other libraries/Public libraries	N/A	N/A	2	2
Total	51	44	16	111

Table 10. Weighted scores of research information sources mentioned by social science students

Source Type	Zone 1	Zone 2	Zone 3	Total
Internet	39	10	N/A	49
Library collections	12	8	6	26
Interpersonal channels	6	10	4	20
Personal collections	3	2	N/A	5
Media	6	2	3	11
Total	66	32	13	111

Table 11. Weighted scores of research information sources mentioned by hard science students

Source Type	Zone 1	Zone 2	Zone 3	Total
Internet	27	2	N/A	29
Library collections	3	10	2	15

Source Type	Zone 1	Zone 2	Zone 3	Total
Interpersonal channels	9	2	2	13
Lab resources	3	2	N/A	5
Total	42	16	4	62

5.2 Perceived Accessibility and Quality as Factors in Positioning Information Sources on the Maps

In this study, the perceived accessibility refers to the ease students perceive in accessing an information source. Based on interviews, properties of the perceived accessibility include convenience, efforts needed, time needed, familiarity, flexibility, etc. Convenience and efforts needed are possibly the most obvious elements in accessibility. Many studies have raised the issue of the principle of least effort in users' information behavior [2]. This study also demonstrates parallel findings. Taiwanese graduate students also place high emphasis on convenience and tend to try whichever they consider the convenient way to access an information source, especially under the time pressure.

Sadie (Soc, M)[4]: Convenience is the most important thing because toward the end of the semester, all you want is get your finals done, so the convenient information sources make me happy.

Hank (Hum, D): The library service is very convenient. You can request the book to your preferred library, which is very nice. Although it makes people lazy, it's really nice.

Selena (Soc, M): I think the library online system is very convenient, so I use it a lot.

Students also regard efforts and time needed as important factors. Students prefer the sources that are perceived not far from them and do not require much effort. They think the faster the sources can be accessed, the less effort they need to make. And it seems that students' information horizon maps start from the computer and themselves, reaching other people and resources.

Selena (Soc, M): [To access sources in] zone 2 need some efforts. For example, you need to walk to someone or something to access [the information source]. For this [sources in zone 1], you only need to sit down and you can start on your own.

Hannah (Hum, D): I usually try the Internet before the library because it is faster. It is easier.

Additionally, lengthy books may also intimidate students. Under time pressure, students tend to read an article or a chapter, instead of a whole book. Some students admit their difficulties or laziness and, to some extent, are intimidated by books. Although reading English books would be much slower than Chinese books, they also clarify that no matter the books are in English or Chinese, they feel almost the same way.

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4 The parenthesis after the participant's name reminds readers his/her discipline and education level by using abbreviations: Hum for humanities, Soc for social sciences, Sci for hard sciences; M for master's level, and D for doctoral level.

Sadie (Soc, M): Because I'm lazy, I accept to read one chapter, but a whole book... I know I don't have time to read, so I put it in zone 3...If it [the book] was in Chinese, I might be a little more willing to read. However, I won't read the whole book, either.

Selena (Soc, M): When I pick up a book, it's hard for me to read from the first page. Because it [the book] is too thick, you don't know where to start...

Other important elements in accessibility may encompass familiarity and flexibility. Students usually turn to information sources that they are familiar with. Unfamiliar information sources may be in the outer field of their information horizons. Sources they do not even know may be excluded unconsciously.

Hank (Hum, D): I am familiar with other ways [to access the information source], so I access the resources in my familiar ways. I don't do something that I am not familiar with and stumble around.

Selena (Soc, M): I did not use or I didn't want to use certain resources probably because I don't know them. Probably once I know how to use them, I will love them.

Craig (Sci, D): I used journal articles a lot because it is easier to find journal articles. You can use the Web of Science. It's hard to find a conference paper.

Students also mention that they prefer a source they can access on their own, rather than relying on others, since it is more flexible to work on their own. This reiterates the previous point that students perceived sources that can be accessed by using a computer requires less effort, and thus their horizon map starts from the Internet and online resources.

Sadie (Soc, M): [When searching on the web], you can look up in a dictionary, you don't feel you're wasting people's time, and you don't worry about how long it will take or how fast you can read. No one monitors you. I think that's more flexible and comfortable.

Perceived quality refers to the characteristics of information sources that students consider relevant or suitable to use. Based on the interviews, the properties of perceived quality include authority and credibility, helpfulness, publication date (if it is recently published), and relevance. Authority and credibility are important attributes that graduate students emphasize. When the students mention the online resources to which they refer in their papers, they usually assess the authority and credibility of the Website by its reputation or credentials of the author and/or the institution of that Website. Graduate students mentioned that they take reliability and academic style, for example, into consideration when prioritizing information sources or deciding whether or not the source would be appropriate to be included in their papers. Additionally, not only can one assess authority and credibility based on the creator or institution of that website, authority and credibility can also be assessed by interactions with individuals.

Helen (Hum, M): [I used it because] it was a website of a professor. If it is a website of nobody, I won't use it. I will see the credibility [and decide whether I'll include the resource or not].

Sadie (Soc, M): A professor has authority. He knows what academics want. He has more experiences, so he knows what you need to include [in your paper]... These are what the Websites cannot offer you, so I think they are supplementary.

Selena (Soc, M): I believe if I can find it [from the library], it is reliable... I would like to make it look academic, and the databases from the library are helpful. For example, the resource

I need is a fairy tale, so I go to the library [online catalog], I can find some [original] children's books, rather than other versions that have been adapted in a movie or something.

Some graduate students mentioned that they sometimes determine the preference or importance of information sources by its helpfulness to their research. When it comes to information sources that they are not sure are helpful, they tend not to regard the source as top priorities. Similarly, when asking people questions about their research, students tend to ask the ones they think have enough expertise to be helpful to their research.

Sadie (Soc, M): My dad sometimes tells me how to write my thesis. He'd say: you need to have a goal and a question, and blah, blah, blah…He shows me his master's thesis. I think it could be a resource, but I don't know if it would be helpful…So parents' opinions may be another resource, I don't know if it is helpful though.

Charles (Sci, D): Professors are definitely important to us, but colleagues are only sometimes helpful…Everyone has his/her own research interests.

Sadie (Soc, M): I think the wording of your questionnaire is important and they [colleagues] are Americans, so I ask them to look at my questionnaire and change the wording for me.

Additionally, recently published materials are especially preferred by science students. Although all of the science students showed concerns about the accuracy of conference papers, they all put very high premium on recently published journal articles. On the contrary, all science students mentioned the outdated books are not very useful for their research.

Charles (Sci, D: Actually, we don't need to survey a lot of papers because our research topics are usually about very new ideas. For example, the area of my research topic starts from 2001, so I cannot go further before 2001 [I can probably find nothing on my literature before 2001]…The most highly used [material] is conference proceeding because it is the latest one. The next would be the journal or transaction, and the last would be the textbook because it takes so long to publish a book. It might take several years.

Chris (Sci, D): Books are usually too old, so they are not valuable for writing papers for publications. We would prefer journals or conference papers. Conference papers are newer, but they sometimes make mistakes. Journals are usually peer-reviewed.

Craig (Sci, D): I think journal papers are more accurate [than conference papers]. Sometimes conference papers are only about people's research process. You may get some new ideas from them, but they are not done yet.

As for social science students, they preferred recently published materials under some circumstances but did not stress as much as science students. Social science students mentioned that for some topics related to media or policies it is very important to include the up-to-date information so as to get an in-depth understanding about the topic. However, they also admitted the importance of some classic books or articles, especially on certain crucial concepts or theories.

Sadie (Soc, M): I prefer recently published journal articles, especially on the topic of adolescence's media use, because the media change so fast. I think the more recent ones [articles] are more helpful.

Chris (Sci, D): I think theses and dissertations are more helpful [than books] because it is his own research, the author knows it very well.

Finally, relevance is also an important property of perceived quality. Students emphasize that the information they need is the relevant materials to their research topic. Students may do the known item search for a specific author or title on the search engine, the library Website, or the database, especially when they know the important scholars, articles, or books in their research area. When they think the source they found is highly relevant to the topic, they often use strategies like snowball techniques to gather more relevant information for their papers.

Helen (Hum, M): I'll put it [personal collections] in Zone 2 because I'm not sure if it is directly related to my topic, and I don't know if it is reliable… Personal owned materials tend to be more general, but writing a paper should be more specific. So I'm afraid it wouldn't be closely related [to my paper because what I owned are basically textbooks]. I'll see if I have directly relevant materials [personal collections]. If I think I owned something really relevant, I'd definitely go find it.

6. DISCUSSION

6.1 Information Horizons and Source Positioning Considerations for Students from Different Disciplines

All graduate students prefer sources through the Internet, including search engines, databases, library online catalogs, and so on. However, graduate students from different disciplines have different preferences for information sources and channels. Compared to humanities and social science graduate students, hard science students tend to use fewer sources, mainly through the Internet, interpersonal channels, lab resources, and library collections. On the other hand, humanities and social science students tend to use a variety of sources through the Internet, interpersonal channels, personal collections, library, and so on. Nevertheless, humanities students uniquely mentioned purchasing books or other research materials while social science students mentioned getting research ideas through the media.

As for the information selection, graduate students of all disciplines not only prefer sources with high accessibility, but also are concerned with the quality of the sources. Although the Internet is always highly preferred by students in all disciplines, humanities and social science students mentioned their quality concerns. They also tend to judge the source quality when they use those highly accessible resources in order to maintain a certain level of credibility. However, contrary to Savolainen and Kari's finding on Internet users' information seeking, interpersonal channels in research contexts was not perceived as an easily accessible source or channel in general [14]. Students mentioned that familiarity and friendliness may influence their perceived accessibility to that interpersonal channel. In addition, students also mentioned that even if professors are nice, they think professors are extremely busy, which sometimes impedes them from asking professors questions. All these perceived factors may constitute graduate students' positioning of the information sources in their information horizons.

As for perceived accessibility per se, students prefer whatever is online regardless of where the actual source comes from. For instance, even if personal collection would be physically close to

them, some students prefer online because it does not limit the source to a certain place like their "home" or their "office." Another example would be the use of document delivery services. Almost all students mentioned the convenience of the Library Express service.[5] Some students point out that they do not care whether or not the article is in a locally owned journal simply because it is very convenient to use Library Express to place a request. That is, students care more about the convenience of the information channel through which they access an information source, rather than where the information source came.

Interestingly, hard science students tend to judge an article by the times cited as well as the academic reputation of the author while humanities and social science students don't. Although the Internet is always placed in Zone 1 by students in all disciplines, it is also placed in Zone 3 by humanities students due to quality concerns. Contrary to the findings from Savolainen and Kari on everyday information seeking, the current study did not show a clear difference in students' selection criteria among the three zones [14]. For example, there may not be a clear difference between the selection criteria in Zone 1 and Zone 2. One of the possible reasons might be the different context. For everyday information seeking, people tend to place whatever is accessible in Zone 1. However, students tend to use what is convenient to them when doing research. In the meanwhile, they also tend to judge the source quality when they use those highly accessible resources in order to maintain certain level of credibility. Therefore, there are no obvious differences in information selection by perceived accessibility and quality in Zone 1 and Zone 2.

Overall, students across the disciplines agreed that their positioning criteria for Zone 1 are mainly based on convenience and perceived usefulness or importance. Some students mentioned they also consider the familiarity and flexibility. A tendency of including both perceived accessibility and perceived quality are salient. Information sources positioned in Zone 2 were those that needs some efforts, provides more general rather than specific ideas or definitions (sometimes not directly cited in the paper), are not that frequently used, or resources that may not be very reliable. Finally, information sources that were positioned in Zone 3 were those with no urgent needs, may trouble others, are too expensive, and require the most efforts (need quality control, are too far, need to read a lot to get only few ideas, need to be prepared before asking others).

6.2 Networks in the Information Horizons for Taiwanese Graduate Students

Networks as one of the fundamental concepts in students' information horizons could also be discovered from the results in this study. The networks in students' information horizons in this study can be generally divided into two categories: social networks which started from interpersonal channels and resource networks which started from information sources other than interpersonal channels.

One of the important network structures is the social networks starting from interpersonal channels. Interpersonal channels such as professors, senior colleagues and colleagues usually refer students to other useful information sources, including prestigious

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5 Library Express is the UW-Madison's document delivery and interlibrary loan service.

scholars, articles, books, or online resources. Almost all students talked about the suggestions from the professor. For example, Selena mentioned that sometimes the professor may suggest you to read some journal articles or something that he has read before. However, an noticeable outlier in sciences mentioned that he thinks his advisor is too busy and has no time to talk to him, so he sometimes emails the professor only to report his progress, not asking questions. And thus, unlike other Taiwanese students, he placed the advisor in zone 3. This may be another aspect of the perceived accessibility concern.

An interesting finding here is that Taiwanese graduate students tend to specify senior colleagues from their peers in the same class year, senior colleagues may be considered more experienced and thus be one of the good interpersonal information sources. For example, Sadie mentioned that sometimes senior colleagues would suggest you to look at someone's articles, or suggest you add some articles on certain topic to make [your literature review] more complete.

Another important network structure is the resource networks which usually start from bibliographies of important sources. Most students mentioned bibliographies from a highly relevant article or book usually lead them to a vast amount of other useful information sources. Among the students, Hank pointed out that "there are a lot of bibliographies in the Norton [textbook]. Those bibliographies were edited by professors, so I found it as treasures that can help you find [useful materials] very quickly." Other interesting networks could start from previous syllabi, relevant theses, or online resource such as Google Scholar. For instance, Charles mentioned that "before someone published his/her thesis, he/she usually published something in other format. So I'd try to use the author to search other articles."

6.3 The Effects of Language Issues and Previous Experiences in the Information Source Positioning for Taiwanese Graduate Students

Some other interesting findings of the study come from the concerns of international students. Although writing center instructors were not positioned in the center of students' information horizons (positioned in Zone 3), humanities and social science students tend to mention writing center instructors while hard science students don't. Humanities and social science students mentioned that consulting with writing center instructors either helps convey their ideas more clearly in English or helps them with academic English usages.

Other language issues include being afraid to cite Chinese works in English, being afraid to repeatedly ask people questions due to language barriers, and so on. For example, Selena mentioned that she is afraid of translating what she has read in Chinese and citing it in her paper since she may not translate or summarize the passage accurately, and she does not know the citation format of citing works in other languages. However, she also mentioned the difficulties when she knows she read something in Chinese but does not know how to find an article or book in English that talks about the same idea. Sadie mentioned worries about asking people questions in person. She said that "you know he [the professor] is busy and you don't want to bother him too much, so sometimes when you don't really understand his answers, you don't want to ask him again. If you browse on the Web, you can look up in a

dictionary, and you don't feel guilty as you are not wasting other people's time."

Students also have concerns about the price and fees of services, based on their previous experiences in Taiwan. Hannah pointed out that "since whatever you buy here [in the United States] are much more expensive than in Taiwan, so I hardly ever purchase books or scores here." Selena admitted that "I don't know if there is a fee for the [document delivery] service, so I didn't use that service. And I am not sure if that article is a highly related one."

In sum, Taiwanese graduate students are concerned with some language issues and naturally relate their previous experiences in Taiwan. These concerns can also be viewed as another aspect of perceived accessibility which may affect their information source positioning and thus influence their information horizon maps.

7. LIMITATIONS
Several limitations of this study exist. First, the result of this study will not be able to be generalized to a larger population. Due to the small population of Taiwanese graduate students at UW-Madison and the small sample size for the qualitative research, there were only nine participants in this study. In addition, although the study sampled graduate students according to their disciplines, students from sciences recruited in this research were all from engineering related fields. No pure science students participated in this research. Furthermore, participants were all from the same institution, and their education level did not match the discipline well. All social science students were in master's programs, while all hard science students were in doctoral programs. Moreover, the retrospective design relied on students recalling their research related activities. However, students may not recall all the information sources in their coursework related activities, which may have influenced the results of the present study. Finally, although this study had a second coder for the instrument translation, were it be a second coder for data analysis, it would help increase the validity of this study.

8. CONCLUSION
Information behavior studies have proliferated with the rapid development of the Internet, shifting the focus from traditional demographic variables to contextual, situational and role variables. This study tried to incorporate the two sets of variables, exploring the similarities and differences among students from different disciplines within situations under research contexts. Since people's information horizons orient their information seeking behavior, discovering users' information horizons help understand users' information seeking behavior. We may expand our knowledge of what information sources and channels graduate students prefer or perceive as important to them, and why they tend to use or tend not to use certain sources or channels. Thus, this study not only contributes a better understanding of graduate students' information horizons when seeking information in a research context, but also contributes to the scarce literature on graduate students' information horizons in the field of information behavior, especially in academic librarianship. Additionally, discovering the similarities and differences among disciplines may not only serve as a whole picture of the information horizons for graduate students, but also help illustrate the different nature of disciplines. Although all students tend to include more information sources in the center (most preferable) than the peripheral zone (least preferable) on their information horizon map, students from humanities and social sciences included more information sources in their information horizons than students

from sciences did since science students tend to do a newer topic and focus on his/her own experiment. Hard science students also tend to judge an article by the times cited and/or the academic reputation of the author due to their needs for replicating experiments and their demands for obtaining accurate results.

Furthermore, according to Liao, Finn, and Lu, international graduate students from a unique multicultural user group for the university libraries. Understanding and meeting their needs will help them achieve higher level of academic success and enhance universities' teaching and research capacities [11]. Viewing Taiwanese graduate students as a group of international students with multicultural backgrounds may help find out the characteristics of international students' information needs in terms of positioning information sources and channels in their horizon maps under research contexts. This study could be a starting point for investigating different groups of international students' information horizons.

All of the above may yield some implications for libraries to provide more suitable services to assist graduate students in doing their research. For example, libraries can promote services that students may not know, e.g. interlibrary loan services, document delivery services or request a purchase. In addition, libraries can also provide library orientations or workshops on different databases. In sum, this study may fill the gap in knowledge of information behavior research and shed light on library services as well. Moreover, from this research graduate students may learn their information behavior as well as possible information sources that they can use in their research.

Future research may focus on a specific concept of information horizons, such as social networks, and include different groups of International students and compare with their American counterparts. More interesting findings may also be elicited if we shift our focus on the interpersonal channel since it is an important component of social networks in students' information horizons and there might be underlying cultural differences which influence the interpersonal channels in students' information horizon maps under research contexts. Incorporating social network theory and social network analysis would probably help us gain a more in-depth understanding of students' information horizons under research contexts, and learn more about the similarities and differences among disciplines and cultures.

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11. APPENDICES

11.1 Instruments
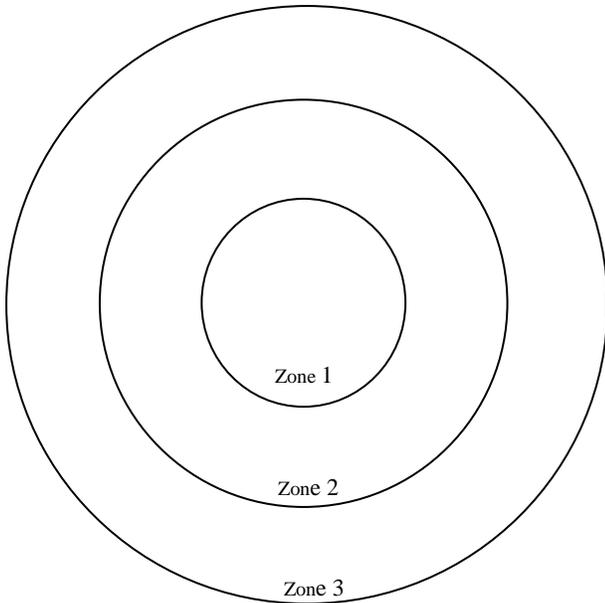
11.1.1 Interview Guide

- Please recall your recent research paper/ project or any other research that is important/ meaningful to you. E.g. your term paper, your thesis or dissertation, etc. And describe your information selection and use experience from the beginning to the end. Can you divide your research process into different stages in terms of information selection and use?

- What do you usually do when gathering resources at the very beginning of your research? (E.g. searching online databases, talking to people, etc.)

- What information resources do you access in each stage of your research? What resources do you prefer in each stage? In what situations do you usually access or not access those resources?

- Among these resources, what do online resources mean to you in each stage of your research?

- Where have you been to access information resources during your research process? Where do you prefer to access information resources in each stage of your research? In what situations do you usually go to certain places to access those resources?

- Among these resources and people, are there any resources or people lead you to other resources or people you access/use?

- Who do you consult with in each stage of your research? Who do you prefer to consult with when you have questions or problems regarding your research? In what situations did you usually consult with or not consult with people?

- Please describe any experience about any resource or people that you once thought about but didn't have a chance to access or use. And explain why you did not access or use it.

11.1.2 Instructions for drawing your information horizons

Please draw a map describing your information source preference for course related tasks (e.g. doing a final project or paper, writing thesis or dissertation, etc.). Please try to include all the resources you use for course related tasks and write the resources you prefer the most in Zone 1, the second preferred resources in Zone 2, and the least preferred resource in Zone 3.
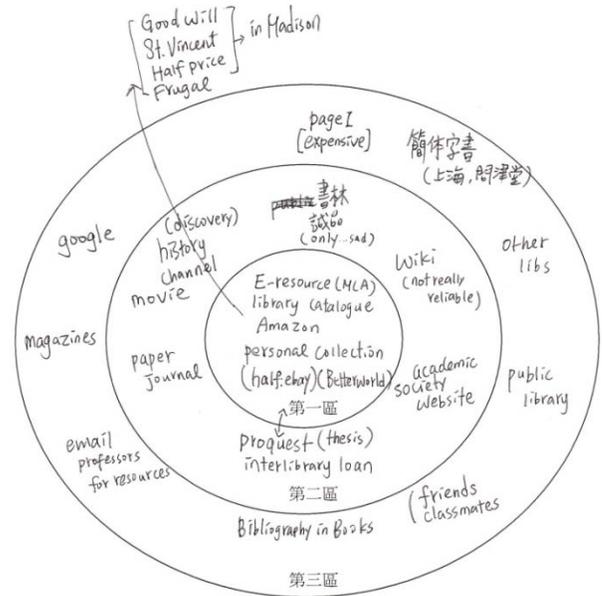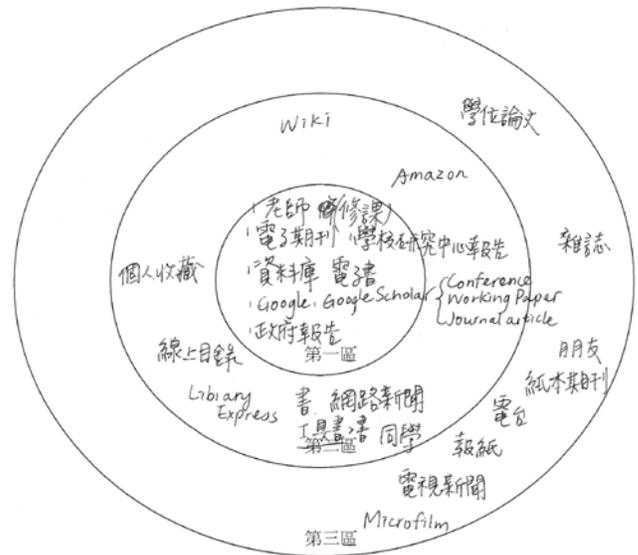
Zone 1

Zone 2

Zone 3

Please explain the resources and channels you include in your information horizon map by giving examples from your course/research related experiences (e.g. doing a final project or paper, writing thesis or dissertation, etc.).

- Among the resources included in your map, what resources do you prefer the most? And why?

- Among the resources included in your map, what resources do you prefer the least? And why?

- Among the people included in your map, who did you consult with when doing your course related tasks? Who did you prefer to consult with when you have questions or problems regarding to these tasks? And why?

- How do you prioritize among the sources and channels shown on your map? What do you usually take into consideration when you access or not access those resources or channels?

- Is there any resource or channel that you once thought about but didn't have a chance to access or use it (which is not shown on your map)? Please describe the situation.

11.2 Information Horizon Maps (Examples)

Map from Humanities Student

Good Will
St. Vincent } in Madison
Half price
Frugal

page I
[expensive]

簡体字書
(上海, 問滬堂)

google

(discovery)
history
channel

書林
誠品
(only sad)

movie

E-resource (MLA)
library catalogue
Amazon
personal collection
(half, ebay)(BetterWorld)

Wiki
(not really
reliable)

other
libs

magazines

paper
journal

Academic
society
website

public
library

第一區

email
professors
for resources

Proquest (thesis)
interlibrary loan

第二區

(friends
classmates

Bibliography in Books

第三區

Map from Social Science Student

Wiki

學位論文

Amazon

老師 (必修課)
電子期刊 學校在研究中心報告
資料庫 電譜
Google, Google Scholar

(Conference
Working Paper
Journal article

個人收藏

雜誌

線上目錄

第一區

Library
Express

書 網路新聞
工具書 同學

電台

紙本期刊

朋友

報紙

電視新聞

Microfilm

第三區

Map from Hard Science Student

Books

journal

Thesis

Internet
cont:
advisor
ieee
iacm
第一區 google < scholar
wiki

第二區

第三區