User-friendly Requirements for Remodeling of Science Libraries:
A Photo-elicitation Study

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Abstract
Due to impacts of the internet and digital technology, the role and function of the university libraries are continually changing. University libraries provide comfortable and convenient spaces that are considered as the "second classroom" for the students. For the College of Science, which gives more focus on experimental light reading, Science Libraries will definitely establish electronic collections, but physical libraries will not be replaced as a result. If Science Libraries are to remain relevant and play a vital role in the higher institutions of education, its design and space planning should take the science students judge most suitable to meet their requirements. This study adopts the following two research methods: (1) the survey is conducted on the basis of random sampling to investigate the purposes of users to the Science Libraries by students; (2) the photo-elicitation method is introduced to understand the user experiences and space requirements of the library. This research used photo-elicitation to conduct interviews with undergraduate and graduate students of National Taiwan Normal University and concluded the following: College students will continue to use all the difference services provided by the library, as well as conduct individual studies, group studies and non-library functional group activities. On individual studies, students would hope to have an independent, private, and multifunctional space; group studies would hope to have information technology usage, multifunctional space for group interaction; as for non-library functional social groups, they would look for a safe, comfortable and easy-going socializing environment.

Keywords: remodeling of library space, photo elicitation

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Introduction

Known as the heart of the university, the university library is the place for providing information and keeping collections. However, due to impacts of the internet and digital technology, the role and function of the university library are continually changing. As early as 1977, Orne speculated that the university library would become the learning center and the place for information utility and shared resources in the university. The library henceforth shall change from a space for library collections into one intended for the enjoyment of all users.

For the College of Science, which gives more focus on experimental light reading, Lucker (1992) believed that the Science Libraries will definitely establish electronic collections, but physical libraries will not be replaced as a result. In fact, they will play more important roles, because the library provides a comfortable and convenient space that is considered as the "second classroom" for the students. Moreover, it is not only a laboratory of the mind, but also a refuge for alleviating stress. Worpol on the other hand believed that future Science Libraries spaces need to pay attention to the cycle and interactive association of the four elements: people, programs, places, and partners (Worpol, 2004).

Shill and Tonner (2004) conducted a survey targeting 182 university libraries constructed or renovated during the period of 1995-2002. Statistical analysis was conducted using four indicators: the number of people entering the library; the book borrow and return circulation volume; the references service; and the number of browsers in the library. It was found that the space planning for improving libraries involved: the expansion of the information space, the replacement of reading tables and chairs, change of the environmental atmosphere, the provision of group discussion, the setup of multimedia production centers, the establishment of cafeterias, and other items, among which, the information equipment and the environmental space atmosphere were the two items that received special attention from the users. Frischer(2002) also mentioned future libraries will be the "Ultimate Internet Café" for enjoying multimedia and accessing various projection equipment; it will also be the only place that provides groups with a complete information environment.

In the era of increasing emphasis on interactive learning, Brown and Long (2006) put forward three design trends targeting the learning space of university libraries: 1. the inclusion of the lively interactive and social space experience; 2. the user demand-oriented information sharing; and 3. the application environment compatible with personal action carriers. Meanwhile, the Scottish Funding Council (2006) planned seven types of learning spaces for university libraries in the U.K., including: group teaching/learning spaces, simulated environments, immersive environments, peer-to-peer and social learning spaces, learning clusters, individual learning spaces, and other external spaces.

Huwe(2007) also pointed out that in response to the needs of the times the library plans to develop flexible modular furniture, as users not only need a quiet reading space, but also a discussion space to express their thoughts and ideas. To find out what a student does in the library, Demas(2005) conducted a research on the Carleton College library use conditions. He observed the following reasons students go to the library: 1. the library provides a safe, comfortable, and quiet place; 2. the library

provides the venue for being with others in the learning environment; 3. the library provides opportunities for learning, consultation, and recreation. University students engage in the following when in the library: read quietly, engage in individual research, engage in group research and discussion, receive and send e-mail, surf the Internet, search data, have meeting discussions, socialize, eat and drink, engage in recreation, and watch exhibitions. Bennett (2005) also mentioned that the group discussion room usage had grown rapidly for doctorate students. It was also pointed out that the group discussion space had a high usage rate in the library; the 250 conference tables, each with 4-6 chairs, were often fully occupied.

In view of the above, the library space was found to be undergoing several changes. These changes included: the practice of user-oriented, instead of collection-oriented, business concept; a comfortable, lively, interactive, diverse, and technological space design as the main focus for the libraries; the user may engage in individual reading, learning and research, data search, group discussion, exhibition appreciation, and new service experiences; furthermore, the library also serves as the place for students to socialize and enjoy recreation, all of which are important functions of the library.

The College of Science, National Taiwan Normal University has a total of 3,200 teachers, staff, and students. The College of Science's branch library has nearly 200,000 volumes of Chinese, English, and Japanese collections (including books, master/doctorate thesis, expired bound volumes of periodicals, and non-book materials). The services provided by the Science's branch library include: borrowing/returning of books, references service, interlibrary borrowing, electronic resources retrieval, library use instructions, science/general reading promotion, audio-visual equipment services, computer and multimedia equipment, research room borrow services, etc. The reader service spaces currently available include: circulation desk, information retrieval area, newspaper reading area, quiet self-study area, diverse learning area (SMILE), study guides room, discussion room, audio-visual room, books and periodicals reading area, etc. Since its opening in 1991, the library is a seven-story building, with a total area of 5,749.5 square meters. The obsolete space can no longer keep up with the times. Hence, in order to improve service, we intend to engage in space remodeling. Prior to this, an insight into the needs of the teachers and students is considered extremely important. Although Lucker(1992) mentioned that physical buildings of Science Libraries will not be replaced, with the lack of funds and today's digital service precedence, many Science Libraries have disappeared. Therefore, such questions as: "Do the students of the College of Science need physical libraries?"; "What do the students do in the Science Libraries?"; "What are the library space use-related experiences of the students of the College of Science?"; "What are their needs?"; and "What are their comments on the library's space allocation?" remain issues to be explored in this study that shall serve as a reference for the spatial planning of Science's branch library.

Research design

The two main objectives of this study are:

1. To understand the reasons why science students visit the Science Libraries;
2. To understand science students' user experiences and opinions of the space of the Science Libraries.

This study adopts the following two research methods:

1. This study is conducted on the basis of random sampling to investigate the purposes of visits to the Science Libraries by science students of the National Taiwan Normal University. The survey was conducted during October 16-31, 2011. The survey covered a total of 168 students who approached the circulation counter of the Science Libraries to loan, return books or use other services during the survey period.

2. The photo-elicitation method was introduced to understand the user experiences and space requirements of the library. The interviewees are 12 undergraduate and graduate students of the College of Science of the National Taiwan Normal University. They are frequent visitors of the library with more than one year experiences in using the Science's branch library and they visit the library at least three days a week. The data of the interviewees are listed in Table 1.

Table 1: Analysis of Data of Photo-elicitation Interviewees

No.	Department	Year	Gender	Frequency (days/week)	Note (Number of photos taken)
S001	Department of Chemistry	Senior	Female	6	16
S002	Department of Earth Sciences	Senior	Male	7	10
S003	Department of Chemistry	Junior	Female	7	7
S004	Department of Earth Sciences	Senior	Male	5	53
S005	Department of Physics	Junior	Male	3	10
S006	Graduate Institute of Envier mental education	2nd year Master Student	Female	5	39
S007	Department of Mathematics	Senior	Male	6	12
S008	Department of Mathematics	Sophomore	Female	5	20
S009	Department of Mathematics	Junior	Female	4	16
S010	Graduate Institute of Life Science	2nd year Master Student	Male	3	24
S011	Graduate Institute of Science Education	2nd year Master Student	Male	4	47
S012	Graduate Institute of Computer Science and Information Engineering	2nd year Master Student	Female	3	16

(Table made by the researcher)

The research process is as follows:

1. To request the library staff at the circulation counter to orally ask their purposes of visits of science students who approached the circulation counter to loan, return books or use other services during the period October 16-31, 2011. At the same time, questions were also asked to establish whether, in addition to the Science Libraries, science students take advantage of the Main Library situated in the other campus. The total number of interviewees at this stage is 168.

2. To have 12 interviewees participate in the photo-elicitation by consent. The interviewees were requested to use digital cameras to take photos inside the Science branch library, to shoot any library space where he or she had used before or wanted to express his or her opinions. The photo-shooting activity lasted for the average of 20 to 30 minutes and the 12 interviewees took the total of 270 photos.

3. To invite the interviewees to express his or her motives and opinions of the photos taken. The researcher then loaded the photos into a laptop computer and reviewed each photo in front of the laptop computer with the interviewee while his or her memories were still fresh. The researcher allowed the interviewees to freely express his or her motives and opinions. The average time of interview lasted for around 45 minutes.

4. The researcher provided a total of 100 photos of library spaces in Taiwan's and overseas libraries, asking the interviewees their needs and opinions of service spaces and learning spaces in the library. The average duration of interview is 45 minutes.
The photo-elicitation at stages three and four lasted for about 90 minutes. All interviewees felt this type of interview was relaxing and interesting, and did not think the interview lasted too long. The complete interviews were recorded and made into transcripts to facilitate the subsequent data analyses.

Research results

Purposes of science students' visits to the library

The survey results show that science students' visits to the library are as follows in the order of frequency: 1. Reading, self-studying or discussion; 2. Searching for information; 3. Using copy, scanning, printing equipment; 4. Loaning, returning books, interlibrary loan, service. There are also other non-library functions, such as taking a rest, waiting for someone else, filling one's time. Table 2 illustrates that most users in the library are undergraduate students and no graduate students ever use study or discussion rooms. The reason for this is because the academic departments have provided graduate students with research rooms or discussion rooms. Therefore, graduate students do not need the study room inside the library while undergraduate students, by contrast, need study rooms the most.

Table 2: Purposes of science students' visits to the library

n=168

Purpose of going to the library	Undergraduate students	Post-graduate students	Total	Ranking
Loaning and returning books, interlibrary loan, literature transmission service	27	11	38	4
Reading, self-studying or discussion	65	7	74	1
Searching for information	55	7	62	2
Using video or audio data	10	1	11	7
Using copy, scanning or printing equipment	39	6	45	3
Using study room or discussion room	14	0	14	6
Others (taking a rest, waiting for someone else, filling one's time etc.)	34	3	37	5

In addition to the Science Libraries, the study also focuses on whether students use the Main Library located in the other campus. The survey results show that 70% of the surveyed students actually have used the Main Library but their use frequency is not high. Most interviewees described themselves as occasional or rare users, which demonstrates that the Science Libraries are still the top choice of the science students.

Opinions on the current library space

We categorized the photos taken by the students into the following areas and requested them to offer their opinions below:

1. Circulation service counter
The interviewees are positive about the location and functions of the circulation service counter on the first floor. Some interviewees think this service counter is small but beautiful and capable of providing varieties of services while other interviewees think the service counter is too small to be perceived as professional. In addition, interviewees want to have self-checked in/out service in this area to allow users to self-operate.

2. Search area
The interviewees are positive about the standing information searching area to facilitate users' searches. At the same time, students reading and studying in the self-study area on the first floor can have easy access to internet connection for information. The interviewees think the standing searching counter is a good arrangement since it prevents the situation where a user has used the computer for a long period of time. The interviewees also like the information searching desks located alongside the bookshelves from the fifth to seventh floors, which provide convenient access for nearby users in book collections.

3. Collections display and use
Graduate students think the Science branch library has not collected sufficient English books and latest editions are not updated. Apart from this, most interviewees like the Chinese language current periodicals section, novels section, comic books section as

well as videos section, which provide access for them to relax in their study or reading breaks.

In terms of display of collections, some interviewees mention the ambiguous labeling on the shelves of the periodicals section and theses and dissertations section so they often need to seek assistance from library staff. In addition, some interviewees notice the rare use of the reference books collection on the third floor and the Japanese collection on the fourth floor by library users so they suggest these sections be withdrawn.

Furthermore, interviewees are generally positive about SMILE multi learning section wherein users can use the internet to access videos, search for information and undertake learning and studying. However, the computer equipment in this area is said to be quite obsolete which requires replacement.

4. Reading area

The 12 interviewees all like the quiet self-study section on the first floor and the noisy corner section on the second floor, which separate users who need a quiet reading environment, students who need to use computers and those who quietly engage in discussions. This is praised as a very good arrangement. In addition, most interviewees enjoy the window-side and sunlight-lit personal reading desks located from the fourth floor through to the seventh floor. These desks are also very private so the interviewees can pay full attention to their studies. They also like sofas in the SMILE area on the third floor since they feel relaxed when reading periodicals or comic books.

5. Group discussion room

The interviewed undergraduate students mention that they often use the group discussion rooms located on the third and fourth floors because they need to undertake discussions to complete their group reports. However, due to the limited number of the group discussion rooms, they often take advantage of the noisy corner section on the second floor. Some students like the transparent glass door and wall design of the group discussion rooms while other students feel the complete loss of privacy. Moreover, they complain about the poor sound-proof effects and obsolete facilities of the group discussion room on the fourth floor.

6. Research room

All four graduate interviewees have used the research rooms but they spend most of their time in the department's research rooms to conduct experiments and studies. Their low willingness to use the research rooms is largely influenced by some regulations, such as the application for one-month only, application for alternate month, cancellation of the right to use in case of insufficient days of use. Despite, they still identify the areas which need to be improved by the library, i.e. poor sound-proof effect, strong sunlight without curtains, obsolete lighting equipment, desks and chairs.

7. Exhibition space

The College of Science Branch Library holds regular exhibition on new books, science exhibition and irregular arts exhibition by the University faculties and students. Cultural and creative products of the National Taiwan Normal University are for display and sale. Most interviewees are positive about the display and sale of cultural and creative products of the National Taiwan Normal University because they become aware of the cultural and creative gifts of the university. They also like the

new book display rack alongside the circulation counter on the first floor. However, an interviewee points out that he could not find a book on the book shelves on the seventh floor but later located the book in the new book display rack, which, as the interviewee perceives it, shows that the library system fails to label the location correctly. The interviewees also notice that the library often utilizes the wall on the second floor for art exhibitions and think this is a good arrangement since they can appreciate artistic works while reading in the library.

8. Leisure and social area

Most interviewees like the sofa area on the first floor since they use this area for taking a rest, reading, waiting for someone else or engaging in discussion with classmates. In addition, the interviewees are positive about the newspaper section located outside the access control area. They enjoy reading newspaper with ease but complain about the excessive number of people from outside the university who have affect students' right to use this section. They hope that the newspaper section can be moved inside the access control area and outside access is only allowed by way of exchange of identity cards.

9. Other equipments

The interviewees are positive about the copy machines located on the first, third and fifth floors and often use them. They think the locations of the machines are adequate and convenient. At the same time, they like and often use the scanning and printing equipment in the SMILE area located on the third floor, but hope scanning equipment and LAN copy printer of better specification can be purchased.

In addition, some interviewees notice that there is an electric piano at the corner on the second floor and think the library's provision of a piano for users to practice is a very special service.

Learning Space Requirements

Library is not only a place to read and study for students, but also a place for diverse learning. Therefore, aside from the photos we take inside the library, we also display library photos from abroad to trigger user creativity and needs towards library spaces, which divides into individual study space, group discussion space and social space.

1. Individual Learning Spaces

In general, library learning space may include information display and usage area, reading area, and research area. 12 of our interviewee have expressed their desire for libraries to provide individual reading tables and chairs to protect their privacy, and a large table to place laptop computer, textbooks, and stationary as well as providing power outlet and lamp.

Graduate students want a smaller study space: a space that is both independent and private, thus, a space with clear glass that can be seen from the outside is unacceptable; they also want a table that comes with power outlet with ergonomic chairs, bookshelf to place books, and windows with natural light and outside sceneries to view as well as curtains to maintain their own privacy. Moreover, some even expressed the desire to wear slippers inside the space as if they were comfortably studying at home.

2. Group Learning Spaces

The group learning space inside the library includes the discussion tables in the reading area and the Group Discussion Room. Graduate students do not have a high request for group discussion space, but there were eight college students who expressed their need for library discussion tables and Group Discussion Rooms to work on study discussions and group reports. As for discussion tables or Group Discussion Rooms, interviewees want a computer monitor or white board, and a power outlet to use their laptop computers; some interviewee wanted the discussion tables to separate into 2, 3-4 or 5-7 people. Moreover, they also require white board and computer projection equipment.

3. Peer Social Learning Spaces

The peer social learning spaces in the library include discussion tables, Group Discussion Rooms and rest area. Most interviewees want the library to have more comfortable sofa chairs and a rest space to engage in social activities. Furthermore, interviewees also want cafes with coffee and light meal placed inside the library to provide a relaxed environment to dine, read and socialize.

4. Spatial Atmosphere

Interviewees want libraries to combine characteristics from the Faculty of Science to design features unique to the Faculty of Science Library, including public art exhibition, set up study corners for different fields of science to transform the library into a second classroom.

Conclusion

In a digital age, the demands for library spaces have changed according to the diversification of student learning styles. This study used photo-elicitation to conduct interviews with undergraduate and graduate students of National Taiwan Normal University and concluded the following:

(1) College students will continue to use all the difference services provided by the library, as well as conduct individual studies, group studies and non-library functional group activities. On individual studies, students would hope to have an independent, private, and multifunctional space; group studies would hope to have information technology usage, multifunctional space for group interaction; as for non-library functional social groups, they would look for a safe, comfortable and easy-going socializing environment.

(2) College undergraduate students will conduct activities such as reading, studying, and researching in the library. At the same time, due to the increase of group research activities, the need for group discussion spaces provided by the library has also increased.

(3) College graduate students will conduct reading, researching and individual studies in the library. However, due to the fact that they mostly stay in the research labs performing experiments and discussions, their need for group study spaces is not high. As Worpol (2004) puts it, the future of Science Libraries Spaces would focus on the cycle of the four elements of library users (people), learning activities (programs), spaces (places), and shared resources (partners). Using National Taiwan Normal

University Science Branch Library as an example, the original library collections will be assessed for the amount of usage and slowly replace it by digital version and convert the space for public usage. University Libraries are comprised of rich and diverse information, services, and activity and space resources and it will remain an important place of learning. Moreover, the future of the Science Libraries will create an exclusively science atmospheric style, and a comfortable and safe home-like environment for users. Using clear labeling system with Information Computer Network Technology, it provides diverse combinations for academic studies as well as social activities for all different users.

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