The Differences Between the Influences of Synchronous and Asynchronous Modes on Collaborative Learning Project of Industrial Design

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Abstract. Understanding communication in collaborative design is helpful for development and selection of communication software and technology in design project. The aim of this article attempts to explore the differences between the influences of synchronous and asynchronous modes on collaborative design learning projects. Two experiment projects were conducted, and the participation record and the content of communication were collected. Both quantitative and content analysis methods used in order to indicate the attributions of different communication mode. Results of this study showed that there have differences in participation and communication pattern between the synchronous and asynchronous modes on collaborative learning project. It should be noted that this study is restricted to the size of sample and uncertain variables. The future research is obviously required.

Keywords: collaborative design, computer mediated communication (CMC), industrial design.

1 Introduction

In recent years considerable concern has arisen over the computer (Internet) support collaborative design. Many researchers and educators have using the tele-communication technology to conduct or mediate the collaborative design projects. The forms of computer mediated communication (CMC) can be synchronous or asynchronous, and the channel (content) can be multi-media, include the text, audio, and video etc. Communication is a critical success factor in design [7]. It is important to understand the communication processes for improvement of communication. Although there has been some research done on analysis and compare the face-to-face and the computer-mediated-communication modes on collaborative design, little is known about the differences between the influences of synchronous and asynchronous modes on collaborative design.

The purpose of this study is to understand the participation and communication pattern in synchronous and asynchronous modes to better determine the influence of difference communication mode on collaborative design. Such research is still in its infancy, but it may have a contribution to make to understand the CMC and the online collaborative design.

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2 Analysis of Online Design Communication

Since 1990s, numerous models of virtual design studio have been introduced [1, 10], and most of them focused on collaborative design. But the results and the influences of using the Internet and information technology in design education still need to be research and prove [8]. Communication is an important factor of successful design, whether in face-to-face or virtual design studio. The analysis of the design communication can help to better understanding of the design process. There are several strategies for studying design behavior include the think-aloud protocols, content analysis, process isolation and situated studies [3], in which the content analysis is contributed to analysis the content of CMC to provide a rich data for researching and understanding online design and learning [6, 9].

Simoff & Maher [11] proposed various approaches to study the communication in online collaborative design included the text analysis, data mining, and visualization of the content. Gabriel & Maher [4, 5] based on protocol analysis method, proposed a coding scheme (Figure 1) development by using data, external and theory-generated structures in order to code verbal design representations in collaborative design.

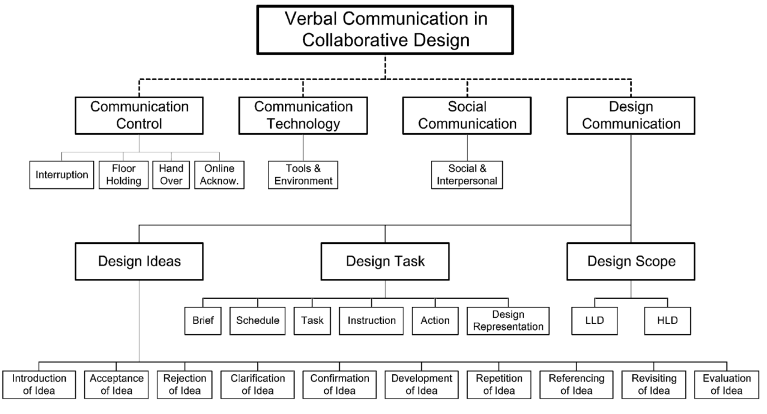

Fig. 1. A hierarchical tree of the coding scheme: verbal communication in collaborative design [Gabriel & Maher, 2002, p.206]

Simoff & Maher [11] and Gabriel & Maher [4, 5] provide various approaches to analysis the communication content for researching and understanding the collaborative design. The approach for this research was referred with those approaches with empirical data to explore the participation and communication pattern in online collaborative design learning project.

3 Method

Two experiments collaborative design learning project were conducted to collect the data and content analysis used to explore the participation and communication of different CMC modes on collaborative design learning projects.

3.1 Experiment Projects

The participants in this study were 33 undergraduate students majored in industrial design in two universities in Taiwan, the National Yunlin University of Science and Technology (NYUST) and Chang Gung University (CGU). The variables of the projects are list in Table 1. In project A, NYUST and CGU used the same schedule and design theme, and used synchronous as primary communication mode. There are 13 volunteers from the NYUST and CGU participated the project and cross group into two teams. Project B used asynchronous as primary communication mode and 20 volunteers from the both universities were paired grouped into 10 teams. But the schedule and design theme is different. Both projects emphasize the collaboration in concept design phase. The participants were asked to communication and exchange the ideas once per week at lease, and every participant had to propose their own design solution by themselves finally.

Both projects used "CoCreaThink Design (http://thinkdesign.cgu.edu.tw)" [2] as the platform for communication and share the design documents. The synchronous mode provides the video-conference, e-whiteboard, text chat, and file-sharing functions. The asynchronous use the forum that with attach function as the main communication channel. Causing the bandwidth and quality of the Internet, the project A using the text based chat with file sharing function as the main communication channel finally.

Table 1. The list of variables for the 2 experiment projects

Project	*A (Synchronous mode)*	*B (Asynchronous mode)*
Theme	CGU/NYUST: Healthy product	CGU: Hair Dryer NYUST: Cultural gift
Participants	CGU: 7 NYUST: 6	CGU: 10 NYUST: 10
Grouping	Cross group into 2 teams	Pair group into 10 teams
Period	NYUST/CGU: 10 weeks	CGU: 8 weeks NYUST: 6 weeks
requirements	Collaborative in design research and ideation phase, every one should propose the design solution by themselves	Collaborative in design research and ideation phase, every one should propose the design solution by themselves
Collaboration	Concept design	Concept design
Collaborative method	One meeting per week using the CMC (text based chat with file sharing)	Discussion and share the concept and ideas by post the message in the online forum
Platform & Functions	CoCreaThink Design Studio Text based Chat, file-sharing	CoCreaThink Design Classroom Forum that provide the attachment function

3.2 Data Collection

All the data were collected by the MS SQL server of *CoCreaThink Design* platform. The record of the users' participation and the content of communication were collected for future analysis.

3.3 Data Analysis

Both quantitative statistic and content analysis were performed. The analysis used the SPSS statistical software package. First, descriptive statistics of the participation record were computed. Next, the communication content was coded by the coding scheme referred with Gabriel & Maher [5]. Finally, the content coding also was calculated and tested.

3.4 Coding Scheme and Coding

In order to explore the communication pattern of difference CMC modes in online collaborative design learning project, the coding scheme that proposed by Gabriel & Maher [5] for analysis the verbal communication in collaborative design (Figure 1) were used. Gabriel & Maher's scheme has 4 categories and several levels. Figure 2 show the categories and level that this study focuses on. Table 2 illustrated the categories, code, and description of the coding scheme. The detail of the scheme can find in Gabriel & Maher's [5] article.

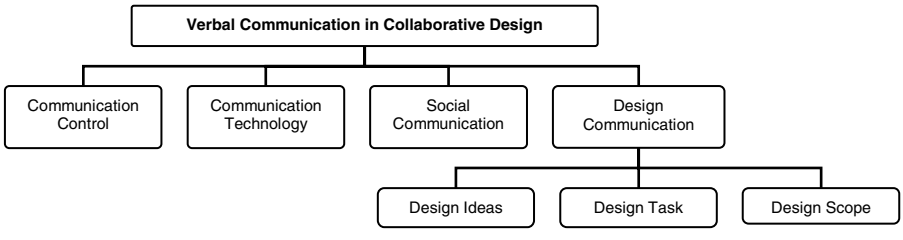

Fig. 2. The coding scheme used in this study

Table 2. The categories, code, and description of the coding scheme

Category	*Code*	*Description*
Communication control	CC	Communication control includes statements made by the designers to hold the floor, to interrupt, to acknowledge presence, and to hand over communication to the other person.
Communication Technology	CT	A data derived structure, looks at discussions held between participants related to the use of the tools and the collaborative environment.
Social Communication	SC	Communication content dealing with interpersonal relationships.
Design Communication	DC	Communication content dealing with the design representation and activities.

Table 2. (*Continued*)

Design Ideas	DI	Includes introduction, acceptation, rejection, clarification, confirmation, development, and repetition, evaluation of idea, and referencing and revisiting an idea.
Design Task	DT	Includes brief, schedule, task, action, and design representation.
Design Scope	DS	Includes low-level design and high-level design.

4 Results

The results of the participation and communication pattern were description in follow. Because the condition and data of the each project were not equally, the percentage was used in order to normalize the value.

4.1 Synchronous Mode

The analysis of the participation includes the frequency of login, contribution of content, and frequency of reading of sharing files. The result of participation analysis is shown as Figure 3. The frequency of login was distributed in every week, and had higher percentages in week 1-5. The contribution of content was increased in the week 2, then kept stable, and dramatically went down at week 5. The frequency of reading of sharing files that participants uploaded was centered on middle and final stages of the process.

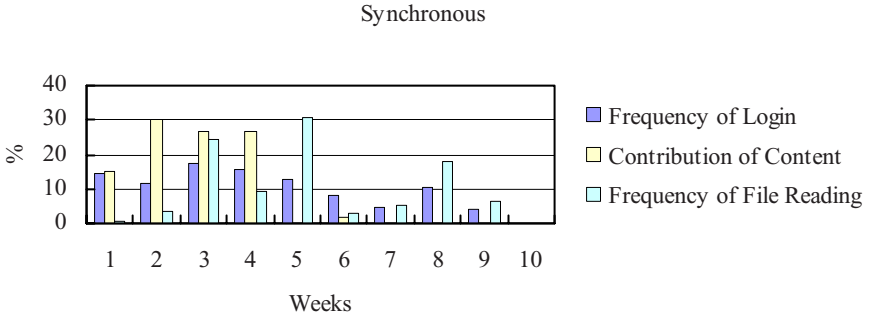

Fig. 3. The distribution of frequency of login, contribution of content and frequency of file reading of the synchronous mode

The percentage of the coded text segments, across the 4 primary coding categories and sub-categories of design communication is presented in Figure 4. The most text segments deal with the *design communication* (46.83%) and *social communication* (41.96%). In *design communication* category, the percentage of *design ideas* (71.70%) is higher than the *design task* (24.67%) and *design scope* (3.63%).

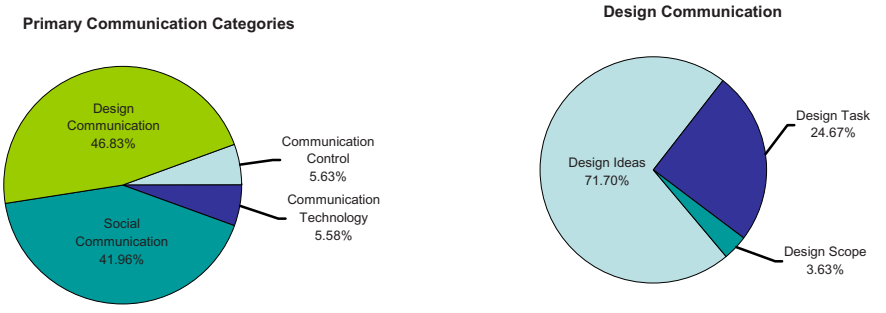

Fig. 4. Percentage of the 4 primary coding categories, and sub-categories of design communication of the synchronous mode

4.2 Asynchronous Mode

The result of participation analysis of the asynchronous mode is shown as Figure 5. The percentage of frequency of login was higher in week 1-2, then dramatic decrease. The distribution of the contribution of content is similar to frequency of login. The percentage of the frequency of file reading was high in week 1-2, then went down dramatically, and increased since week 4.

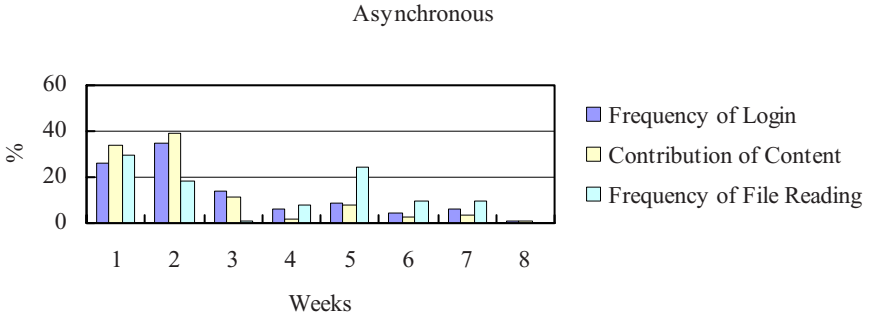

Fig. 5. The distribution of frequency of login, contribution of content and frequency of file reading of the asynchronous mode

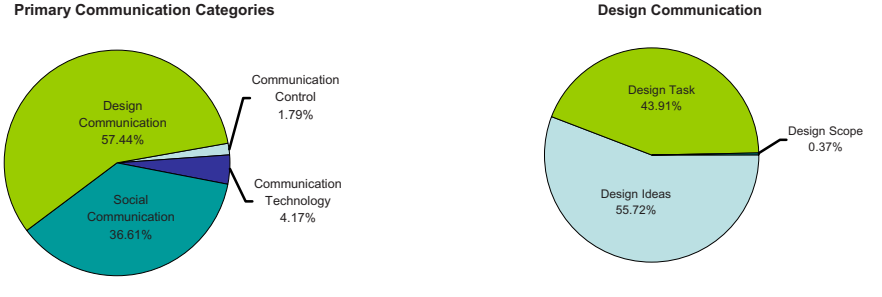

Fig. 6. Percentage of the 4 primary coding categories, and sub-categories of design communication of the asynchronous mode

Figure 6 presented the result of the content coded. In primary communication categories, there were 57.44% content deal with the *design communication*, and 36.61% focus on *social communication*, 4.17% on *communication technology*, and 1.79% on *communication control*. In *design communication* category, 55.72% deal with *design ideas* and 43.91% with *design task*, only 0.37% focus on *design scope*.

4.3 The Differences Between Synchronous and Asynchronous Modes

According the results of participation and communication analysis and observation through the project, there are some differences between the synchronous and asynchronous modes.

Participation. There are several differences between synchronous and asynchronous modes in participation. The participants' login central on the particular date of the team meeting and to continues, and the contribution of content is stable in synchronous mode. In asynchronous mode, the frequency of login is distributed, and the contribution of content is high in initial stage then decrease dramatically.

The frequency of login was dramatic decrease and the interval of login was increase in the asynchronous mode. The more likely explanation is the uncertainness of the feedback. The fewer of the feedback and long time for wait reply will affect the motivation of the participation.

The utterance and the contribution of words of synchronous mode are more stable than asynchronous mode. The contribution of the content seems to be closely connected to the frequency of login. Despite the uncertainness of the feedback, the schedule and the requirement of the project may be the reason for, too.

The frequency of files reading was centered on middle and a later stage in synchronous mode, and centered on the initial and later stage in asynchronous mode. The average time of reading in the initial stage is longer than other stage in asynchronous mode and more stable in synchronous mode.

Communication Pattern. In the results of communication pattern, the percentage of *communication control* was significant difference between asynchronous and synchronous mode. The *social communication* was stable appear during the progress of project both in asynchronous and synchronous mode. In *design communication* level, more *design ideas* segment contributed in synchronous mode, and more *design task* segments was dealt with in asynchronous.

In the synchronous mode there were fewer text segments deal with the *design communication* and more segments concerned with *communication control*, *communication technology*, and *social communication*. The results of the ANOVA showed a significant difference between synchronous and asynchronous in *communication control* ($F=11.619$, $p < 0.05$), and no significant different in other 3 communication categories.

Observation of the projects progress founded that the *social communication* and *communication technology* continuously occurred, and the *communication control* was appeared in the initial stage of project in synchronous. The *design communication* and *social communication* continuously occurred, and the *communication control* and *communication technology* were fragmental appeared in asynchronous mode.

5 Concluding Remarks

This paper presents the results of the participation and communication pattern of synchronous and asynchronous modes on collaborative learning project of industrial design. The results support the conclusion that there have differences in participation and communication pattern between the influences of synchronous and asynchronous modes on collaborative learning project.

These results may be explained by considering the motivation and attitude of participants, and the planning or setting of the project. It needs the more precise research to clear prove. In addition, it is important to emphasize that the data collected from the real learning project may limit the interpretations, and the study involved only two experiment projects, the results cannot be generalized. This study has taken a step in the direction of understanding the difference between synchronous and asynchronous CMC mode on collaborative learning project. The future research will provide more detailed results which may differentiate these views from one another.

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References

1. Broadfoot, O., Bennett, R.: Design Studios: Online? Comparing traditional face-to-face Design Studio education with modern internet-based design studios, AUC Conference 2003. (2003) Retrieved July 22, 2005, from http://auc.uow.edu.au/conf/conf03/papers/AUC_DV2003_Broadfoot.pdf
2. Chen, W., You, M.: A framework for the development of online design learning environment. In: Proceedings of the 6th Asian Design Conference: Integration of Knowledge, Kansei, and Industrial Power (CD ROM), October 14-17, Tsukuba, Japan, I-01 (2003)
3. Craig, D.L.: Stalking home faber: a comparison of research strategies for studying design behavior. In: Eastman, C.M., McCracken, W.M., Newsletter, W.C (eds.) Design knowing and learning: cognition in design education, Elsevier, pp. 13–36. Elsevier, Amsterdam (2001)
4. Gabriel, G., Maher, M.L.: An Analysis of Design Communication with and Without Computer Mediation. In: Scrivener, S.A.R., Ball, L.J., Woodcock, A. (eds.) Collaborative Design, Springer, London (2000)
5. Gabriel, G.C., Maher, M.L.: Coding and modelling communication in architectural collaborative design. Automation in Construction 11, 199–211 (2002)
6. Gerbic, P., Stacey, E.: A purposive approach to content analysis: Designing analytical frameworks. The. Internet and Higher Education 8, 45–59 (2005)
7. Maier, A.M., Eckert, C.M., Clarkson, P.J.: Identifying requirements for communication support: A maturity grid-inspired approach. Expert Systems with Applications 31, 63–672 (2006)

8. McCormick, R.: Collaboration: The Challenge of ICT. International Journal of Technology and Design Education 14, 159–176 (2004)
9. Naidu, S., Järvelä, S.: Analyzing CMC content for what? Computers & Education. Computers & Education 46, 96–103 (2006)
10. Schnabel, M.A., Kvan, T., Kruijff, E., Donath, D.: The First Virtual Environment Design Studio. In: The proceedings of 19th ECAADE-conference, pp. 394–400 (2001)
11. Simoff, S.J., Maher, M.L.: Analysing participation in collaborative design environments. Design Studies 21, 119–144 (2000)