



# Design Patterns for Cross-cultural Collaboration

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The research project discussed in this paper looks at cross-cultural, remote collaboration in design learning. It identifies eleven evolving design patterns. The paper presents a summary of these patterns. In a long-term, ethnographically informed study, I used a mixed method approach to investigate cross-cultural collaboration practices. I analyse data from the first and second year of this study inductively to identify recurring themes and patterns in design collaboration. A deductive analysis in the third year facilitated the articulation of the identified design patterns. Triangulation of data and comparison of Hong Kong/Korean, Hong Kong/Taiwanese and Hong Kong/Austrian collaboration allowed for evaluation of the patterns' validity across cultures. The paper suggests a community-lead evaluation of the proposed patterns for further research. The findings attempt to raise awareness about the needs and possibilities for localizing learning designs and technologies by designers and developers of interactive learning environments.

**Keywords** – Design Patterns, Design Learning, Cross-Cultural Collaboration, Interaction Design, Internationalization.

**Relevance to Design Practice** – The design patterns presented in this paper are applicable in design learning. E-learning professionals and educators can use these patterns to inform ideation and implementation of learning designs and technologies. Expert evaluators of the proposed pattern collection also suggested that some patterns might be relevant in international collaboration in professional contexts.

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## Introduction

Collaboration in design has become a geographically and culturally dispersed activity. Increasingly, design educators see the need to prepare young designers for an international market by providing students with skills not only for design, but also for intercultural communication and distributed collaboration (Sheldon, Bharwani, Mitchell, & Williams, 1995; Cheng, 2003; Bennett & Dziekan, 2005). Accordingly, research into computer-supported, intercultural collaborative design learning is becoming more important. A central problem in this endeavour is the identification of cross-cultural differences in collaboration and how to communicate this knowledge to designers and educators to facilitate the development of courses and interactive technologies.

It has long been known that design patterns can offer a valuable format for the identification and communication of knowledge of successful design solutions for recurring problems (Alexander, 1979). A diverse range of design pattern collections has been developed, including patterns for computer-supported, collaborative working (CSCW, Lukosch & Schümmer, 2006) and pedagogy (Baggetun, Rusman, & Poggi, 2004). Lukosch and Schümmer's pattern collection, for example, offers a wide range of solutions to support collaboration. However, research in international collaboration suggests that solutions for supporting teamwork vary across cultures (Zhang, 2007; Kim & Bonk, 2002). Design patterns often presume a universal validity, but a design pattern is actually situated within a particular context and researchers have not yet examined the validity and effectiveness of design solutions in different cultural contexts. In an increasingly multi-cultural environment, designers and design educators need to be aware of differences that may affect the usefulness of a learning design solution across cultures. A learning design is a

unit of learning materials, technology and assessment. Design patterns that report about the cultural context in which learning designs worked well allow designers of learning content and technologies to make informed decisions about the applicability of those learning designs in their learning environment. The patterns identified in this research build awareness of approaches that support collaboration across cultures.

## Background

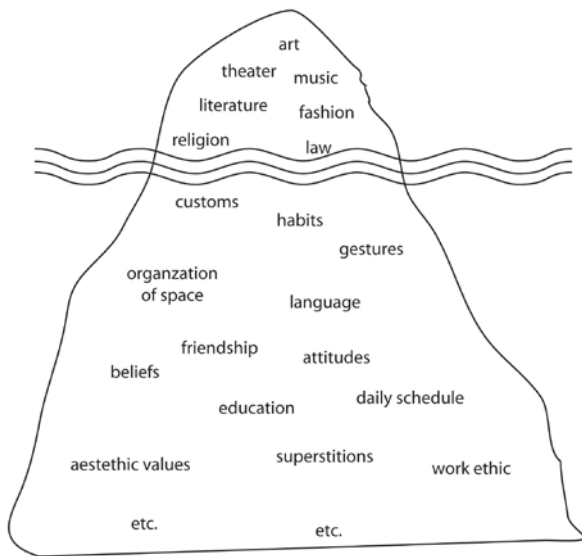
### Culture and Communication

This research adopted a communication related definition of culture. Culture is a system of learned behaviour patterns that is constantly reproduced by human communication using a certain set of symbols. Interlocutors share the meaning of these symbols, or are in the process of developing a shared meaning. In this sense, culture is reflected in symbolic and material expressions (Hall, 1959; Lefebvre, 1991; Hofstede, 1997). The iceberg metaphor of culture shown in Figure 1 illustrates the hidden values that underlay human communication and design expressions, just as the larger part of an iceberg is hidden under the sea level (French & Bell, 1995). Only a small part of culture is visible at the surface.

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**Figure 1. Iceberg model of culture redrawn from French and Bell (1995).**

Researchers have found that the encoding and decoding of communication messages is an interactive process influenced by conceptual filters (Gudykunst & Kim, 2003). Over the last 60 years, research in the area of cross-cultural communication has identified about 29 value dimensions in which cultures differ. Many academics report similar findings among some of the value orientations outlined below (Marcus & Baumgartner, 2004; Gould, 2005). Due to conceptual similarities, several dimensions can be grouped. In the synthesis of the literature for this project a practical set of grouped dimensions for the analysis of cross-cultural collaborative learning evolved (Kluckhohn, 1950; Condon & Yousef, 1985; Hall, 1990; Victor, 1992; Triandis, 1994; Trompenaars & Hampden-Turner, 1994; Hofstede, 1997; Marcus, 2004).

1. **Achievement and Ascription Activity Orientation:** *Achievement Activity* cultures measure effectiveness of an activity by the achievements. In contrast, *Ascription* cultures value understanding the complexity of a situation, attending to attributes in others rather than their achievements.
2. **Equal and Hierarchical Authority Orientation:** This dimension refers to the degree of *Equality* or *Inequality* among people accepted into a society or group. This also relates to leadership styles, roles and the degree of authority (*Hierarchical* or *Equal Authority Orientation*) in an organization.
3. **Collectivist and Individualistic Community Orientation:** Communities and societies may differ in *Collective* or *Individual Community* values orientations. Although

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*Individualistic Community* cultures act according to their individual needs, *Collectivistic Community* cultures consider the needs of the community as much or more important than personal needs.

4. **High and Low Contextual Communication Orientation:** In *High Context Communication*, most of the meaning transmitted in the communication process is in the context, i.e. the immediate surroundings or implicit cultural knowledge. In contrast, a culture in which most things are explicitly stated is a *Low Context Communication* culture.
5. **Neutral and Affective Communication and Relation Orientation:** Cultures with *Neutral Relations* tend to hide their feelings when communicating and interacting with others. *Expressive Relation* cultures do not hesitate to show emotions and affectivity.
6. **Universal and Particular Standard Orientation:** In *Universal Standard* cultures rules are the same for everyone in every situation. In *Particular Standard* cultures, truth and principles are not absolute, but dependent on the situation.
7. **Technology Orientation:** Cultures tend to either accept and favour technology as a positive tool to dominate, structure and master nature (*We Control Technology*), or cultures view technology as means to control a community (*Technology Controls Us*) and consequently not desirable as technology interferes with humans' harmony with nature.
8. **Time Orientation:** *Monochronic Time* societies tend to carry out tasks sequentially without interruptions, whereas in *Polychronic Time* cultures, people are comfortable doing several tasks at once. *Long Time* cultures respect traditions and long-term commitments. In *Short Time* cultures change happens more easily.
9. **High and Low Uncertainty Avoidance Orientation:** *Low Uncertainty* cultures tolerate varied opinions and inconclusive or unsettled discussions. Change is accepted more easily. However, *High Uncertainty* cultures employ rules to control ambiguity and uncertainty. If uncertainty emerges it must be resolved.

Gudykunst (2004) suggests that in intercultural communication people of different cultural backgrounds strive to identify commonalities and shared values to reduce uncertainty in communication. Breakdowns or misunderstandings in communication occur due to varying communication styles, as discussed in the outline of cross-cultural communication research above. Scollon and Scollon (2001) imply that getting to know similarities and differences in communication processes can reduce misunderstandings and increase intercultural competence. Training students directly in intercultural communication competencies is important, but this research found that intercultural competencies and awareness start long before students start to collaborate. The research sought to identify recurring problems in cross-cultural communication in the practice of distributed international design education to inform educators and developers of e-learning systems of the problems that can arise, the aim being to assist them to develop better strategies and tools to support intercultural collaboration.

## International Design Education

Several case studies point to the need to support cross-cultural communication in distance learning (Sheldon et al., 1995; Cheng, 2003; Bennett & Salmon, 2005; Kvan, 2001). Including a cross-cultural collaborative learning module in such learning aims to prepare young designers for the globalization of the design industry, but those who develop distance learning courses are often unaware of the effect of cultural difference on the distance-learning process or how to develop interactive systems and learning designs to support such interaction. The question is: 'how does one come to understand these needs for localization within a collaborative design context?' One way to understand needs for localization is to identify what constitutes 'best practice' in design in varying cultural contexts. Perceptions of best practice are experience-based, codified in tacit knowledge, often identified through recurrence and may be developed further through experimentation. Finding ways to articulate the multi-layered contextual information that is inherent in descriptions of best practice so that what is being communicated is neither too broad nor too specific is difficult. Different approaches such as case studies, design rules, standards, guidelines, or design patterns have been explored to this end in research and practice, the fields of Pedagogy and CSCW increasingly favouring design patterns.

## Design Patterns Research

The work of the architect Christopher Alexander (1979) introduced the concept of design patterns. Since then, patterns have been a much explored method in Software Development (Gamma, Helm, Johnson, & Vlissides, 1995), Localization (Mahemoff & Johnston, 1999), CSCW (Lukosch & Schümmer, 2006) and Pedagogy (Eckstein, 2000; Avgeriou, 2003; Winters & Mor, 2008).

Alexander (1977) proposed that a pattern is a good solution to a problem in a certain context. Design patterns capture best practice in a specific professional domain, allowing its reuse. They support communication among stakeholders and offer a "lingua franca" for design communication (Erickson, 2000). Each pattern describes the context, scope and validity of a design solution, underlining its principles and providing examples. Patterns are interrelated, cross-referenced and organized in collections. This allows the discovery of related problems and solutions in more complex design situations.

Alostath and Wright (2004) and Mahemoff and Johnston (2001) have published work investigating the possibility of pattern-supported cross-cultural usability in the field of internationalization and localization. The patterns these researchers identify offer support for the design process in the internationalization of computer systems, but do not give consistent advice as to which cultural differences or design models need to be applied in different development contexts. Alostath and Wright (2004) propose using cross-cultural dimensions systematically in design patterns to identify the effect of cultural differences on a design. Surprisingly, pattern researchers in pedagogy have not yet considered how cultural values influence learning and the design of e-learning technologies.

The research on which this paper is based sought to identify design patterns for use in cross-cultural collaborative distance design learning by posing the research question:

*Which patterns of cross-cultural computer-supported collaborative design learning can be identified?*

## Methodology

Interaction design patterns can be identified using situated and qualitative research approaches (Guy, 2003; Martin & Sommerville, 2004; Arvola, 2006). This research employed a mixed method approach. A three-year ethnographic study was conducted. Inductive and deductive qualitative analysis methods were used to identify and articulate interaction design patterns (Baggetun, 2004). The inductive approach to data analysis grounded all findings in the data. The deductive approach to ethnographic data analysis used scientific theories to structure, code and report the data to test or extend an existing theory or hypothesis (Tesch, 1990). Finally, a comparative analysis evaluated the validity of patterns across cultural contexts. In this analysis, varying data sets, theories and analysis approaches allowed triangulation of the data. The main tool of evaluation in the cross-cultural comparative analysis was observation of recurrence (or non-recurrence) of design patterns in multiple cultural contexts. Although the pattern identification process is discussed in great detail elsewhere (Schadewitz, 2007, 2008), this section provides an overview of the process.

## Setting

From September 2003 to December 2005, the author observed an undergraduate university design studio titled 'Only Connect - international collaboration project'. The School of Design at the Hong Kong Polytechnic University organized this 6-7-week course, which was taught in collaboration with partner universities in Korea, Austria and Taiwan. Each year, teams of 2-4 second year Hong Kong students from product, visual communication and environmental design were paired with partner teams of 1-3 students from a similar design discipline in another country. Distributed groups worked both locally and globally in virtual teams. Each time, there were approximately 110 Hong Kong participants and 50 international partners. Each discipline had 2-3 tutors from Hong Kong and from the respective partner university.

Students collaborated using various communication technologies. Teams used synchronous communication tools like MSN or ICQ chat systems or Video-supported chat with simultaneous projections of the design work and live video images of distributed student groups (Figure 2c). In addition, teams used asynchronous communication media like email, shared documents and different community (Figure 2b) and group websites like weblogs (Figure 2a) or Yahoo! Groups. Data about the collaborative interactions between the international design teams were collected using naturalistic observation, in-depth and informal interviews, as well as online conversation protocols.

### Analysis

The research project consisted of three phases (Figure 3). In the first year, data were gathered to discover similarities in the teams' interaction and communication to identify recurring issues in intercultural, computer-supported collaboration. The aim was a holistic understanding of cross-cultural collaboration problems and possible solutions to supporting social interaction. Tables 1-3 show how various data sets, analysis methods and theoretical frameworks interrelate and triangulate findings from year to year.

In the first year, summative and thematic coding of concepts was used to identify general themes in the data. Two main categories evolved; Technology and Team Management with recurrent observations of breakdowns, i.e., disparate timing of work, tasks and goals and few video-supported tutorials (Table 1, Column 4, Row 4-5). The expert interviews confirmed and further specified reasons for breakdowns in collaboration, such as the proposition of differing design solutions and lack of awareness of problems in communication.

Appendix A shows a selection of codes and the computer-supported, pattern coding of the expert interviews. It also shows a selection of frequency of codes related to observations mentioned above. For example, breakdowns frequently occurred in the process of finding design solutions (Table 1 Column 4 Row 17).

Communication, particularly where the communication of design ideas was highly contextually specific, using synchronous tools and workflow coordination seemed to tackle breakdowns. This analysis indicated that culture influences team interaction and technology use on multiple levels. Breakdowns in collaboration occur frequently and are more severe in cross-cultural teamwork. However, reasons for breakdowns are blurred. Frequent synchronous, multi-modal communication seems to resolve some problems. Later in this paper I build on these first indications in the data to propose the design pattern GLOBAL RESOLUTION, a synchronous tutorial format. To gain a deeper understanding, the issues identified were used as guidelines to carry out further observations, analyze synchronous communication protocols and conduct interviews with the participants during the second year of the research.

I analyzed the data from the second year of observations in cycles of summative, latent (thematic) and pattern coding. I mapped the emerging categories and patterns onto a hierarchical graph to discover possible connections between individual themes and patterns. Appendix B shows a section of one pattern graph. Patterns in the upper hierarchy reveal general concepts of collaboration, learning goals and in interaction design; patterns lower in the hierarchy suggest possible technical design solutions to those concepts (van Welie & van der Veer, 2003). The graph



Figure 2. a, b, c. Examples of collaboration support for design learning (a. Blog (2004), b. Community website (2003) and c. Video-supported chat and design critique [Picture by Ambrose Wong]).

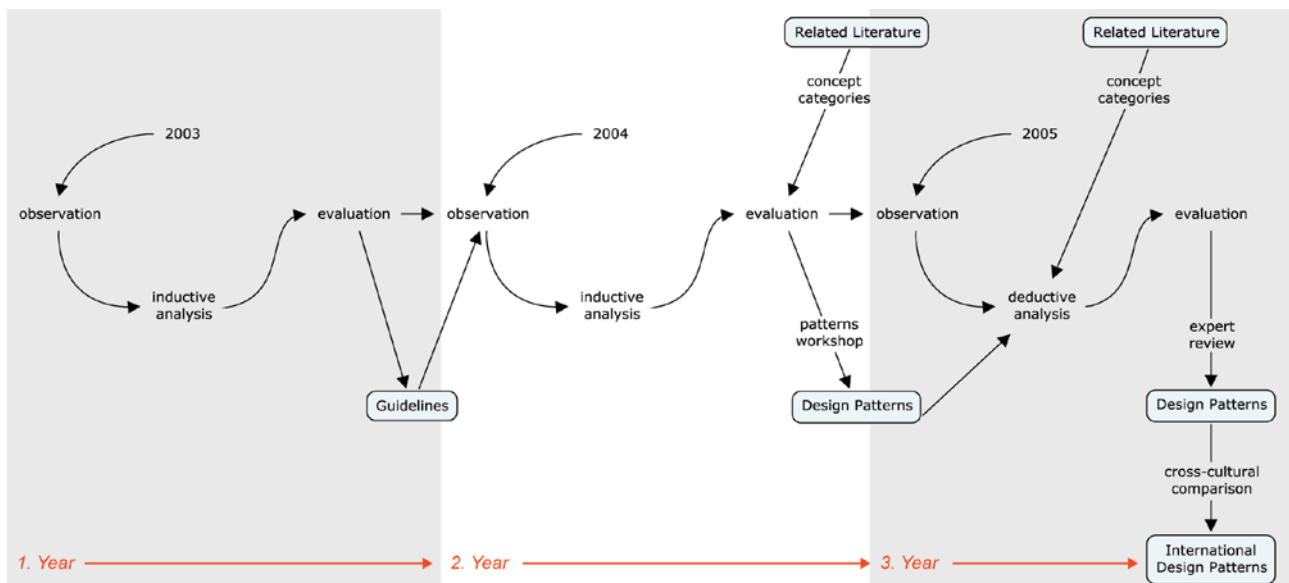


Figure 3. Research process.



nodes in Appendix B show similar observations as in the first year. For example, moderator-guided sessions and peer tutorials were recurrently used to support cross-cultural teamwork. A few emerging solutions to cross-cultural communication problems were tested through design scenarios and paper prototypes. These activities produced 14 preliminary design patterns, which were evaluated in design pattern workshops with novice and expert designers (Figure 4). The disproportionate focus on details of interactive technologies rather than on larger social relationships produced criticism and identified some limitations in the format used to graph design patterns in the evaluative pattern workshop. Among other recommendations, workshop participants found that design patterns were mixed in intent and problem, solution pairs did not always seem to ‘match’ and intercultural collaboration issues were not highlighted consistently in the patterns. This seemed to stem from the focus on technology rather than overarching issues in intercultural design education.

To address issues raised in this intermediate evaluation, patterns were further developed using a deductive analysis of the interactions between Hong Kong and Korean participants in the third year. A deductive analysis allowed for more consistent



Figure 4. Preliminary design patterns evaluation workshop.

analysis of the data and expression of the design patterns. This analysis used established theories and coding schemes from collaboration support including codes such as *Awareness*, *Coordination*, *Communication*, *Content Management*, *Implementation* and *Instruction* (Rogers, Sharp, & Preece, 2002). It also utilized concepts known from intercultural communication

Table 1. Research phase year 1

Team composition	Method		Identification	Findings	
	Data gathering	Analysis	Breakdowns/problems	Design Solutions	
HK-Austria (major) and HK-Korea (minor).	Observations and interviews collection of message board entries.	Grounded theory using summative and latent (thematic) coding.	2 main categories: team management and technology use		
			<b>Team management:</b>		
			Time management differences.	Various collaboration schemes.	
			Dissimilar goals and tasks.	Local work, finding common goal.	
			Too few remote tutorials.	Remote tutorials.	
			Language miscommunication.	Inspiring point of views.	
			Different social interaction intensity expectation.	First friends through informal communication.	
			<b>Technology use:</b>		
			Threaded discussion structure.	Continuous discussion and picture/text integration in thread.	
			Video and synchronous chat shyness.	Chat more efficient over time, video tutorials.	
Community spaces not interconnected.					
Online personal space needed.					
International	Expert Interviews.	Qualitative content analysis using patterns and latent coding Computer-supported. Code Frequencies. Hierarchical network Diagrams.	6 main categories: breakdown, understanding, communication, awareness, coordination, and tool.		
			<b>Breakdowns:</b>		
			Differing language proficiency and use.	<b>Understanding:</b>	<b>Awareness of:</b>
			Unawareness or unknown reason of breakdown.	Share feelings and get to know partner.	Diverse ideas and ways of working.
			Different design solutions.	See differences to other cultures.	Online presence and feedback channels.
			Individual styles of collaborators.	<b>Communication:</b>	<b>Coordination:</b>
				Design ideas and shared artefacts.	Use of shared methods.
				High contextual communication.	Clarify ambiguities.
				Collaboration intensity.	Workflow and scheduling.
			Asynchronous and synchronous tools.		

research such as *Breakdown, Dealing with Breakdown* and *Gaining Common Ground* (Scollon & Scollon, 2001) and cross-cultural communication such as mentioned in the ‘Culture and Communication’ section of this paper, i.e., *Hierarchical Authority Orientation* (Hofstede, 1997). In addition, established coding schemes from collaborative design research, including codes such as *Design Problem* (Maher, Bilda, & Gül, 2006), or pedagogy, including codes such as *Co-Construct Knowledge* (Gunawardena, Lowe, & Anderson, 1997), were used. Codes developed in this process are called sociological codes (Table 3, Column 3), which offer terms and categories for codes based on established sociological or other relevant literature (David & Sutton, 2004).

The computer-assisted analysis software package TAMSAnalyzer™ and GraphViz were used to view, sort, code

and analyze the data (Appendix C). Code frequencies and co-coding frequencies were used to compare the data, find patterns and explore relations among the patterns. Differences in the values of coding frequencies meant dominant patterns in the data could be captured more consistently in the deductive analysis. Moreover, comparison of the co-coding frequencies with other codes identified patterns of stronger and weaker relations. The selection of co-coding frequencies in Appendix C (Row 6) exemplifies the identification of dominant observations with the code Instruction, leading to the proposition of the pattern GLOBAL RESOLUTION. Observations of *Breakdowns* in communication between culturally diverse students could be related to certain cultural value dimensions such as *Hierarchical Authority Orientation*. For example, in a chat conversation:

**Table 2. Research phase year 2.**

Team composition	Method		Identification	Findings	
	Data gathering	Analysis	Breakdowns/problems	Design Solutions	
HK-Korea (major).	Observations and interviews collection of transcripts of e-mail, blog, documents and msn chats.	Inductive qualitative content analysis using summative, pattern and latent coding. Mapping of codes in hierarchical network diagram structured by interaction design categories proposed by Welie (2003). Single solutions tested in paper prototypes.	2 main categories: asynchronous and synchronous collaboration, in each category around 50 codes resulted in 14 hierarchically related, preliminary design patterns.		
			<b>Intercultural collaboration:</b>		
			Designing computer support for cross-cultural collaboration.	Raise awareness of cross-cultural differences in social interaction among members of development team.	
			<b>Blended collaboration:</b>		
			Coordinating distributed work processes.	Blend local and remote teamwork activities.	
			<b>Community workshop:</b>		
			Starting the teamwork process.	Install a co-located community workshop.	
			<b>Community portal:</b>		
			Different social interaction intensity expectation.	First friends through informal communication.	
			<b>Local teams:</b>		
			Structuring collaboration in a community.	Set up local teams that work with other remote teams.	
			<b>Shared database:</b>		
			Exchanging locally produced work.	Provide a shared database to share local artefacts.	
			<b>Team blog page:</b>		
			Representing a local team online.	Create a team page for daily team communication.	
			<b>E-mail:</b>		
Supporting communication ease.	Support use of personal accounts for communication.				
<b>Buddy list:</b>					
Awareness of team members' presence.	List members in a buddy list and indicate activities.				
<b>Personal profile:</b>					
Getting to know a team member's particulars.	Support the creation of a personal profile.				
<b>Project timeline:</b>					
Scheduling teamwork.	Offer an abstract visual and numerical scheduling device.				
<b>Awareness indicators:</b>					
Awareness of members' activities.	Convey information about past, present and future events.				

Hong Kong students asked: “Do u guys know what is our concept as this stage?”

Korea replied: “We saw the animal dressed up set sketch, that is fixed idea?”

Hong Kong answered: “yup. After today tutorial, [local tutor] guided us to develop a set that only contain one item for each meal. ... [Respond to fixed idea] for our side, it probably yes...”

Hong Kong asks: “do u have tutorial with ur tutors about this project? And what’s his comments?”

Korea replies: “He didn’t see yet”.

Breakdowns based on separate local tutorials suggest ways for Dealing with Breakdowns, Gaining Common Ground and collaboration support mechanisms such as Instruction. For example, where students could not resolve issues in local tutorials, video-supported tutorials with local and remote tutors were added. After such a meeting, I asked students about the outcome; they replied “they were happy because the tutors agreed on a direction to proceed”. Such examples suggested the design pattern GLOBAL RESOLUTION. Comparing the patterns identified in the Hong Kong/Korean teamwork with other data sets allowed

me to validate the occurrence or absence of certain patterns in other cultural contexts. For example, the data in Hong Kong/Austrian collaboration did not support the need for GLOBAL RESOLUTION.

The collection of data across geographic boundaries lead to several challenges in conducting the research. However, themes and issues were continuously modified over the three years to improve the study of intercultural collaboration and identification of design patterns. In the first year, findings from expert interviews and a limited conversation analysis gave first insight into general issues that arise in cross-cultural collaboration, such as team interaction and technology use. These findings were confirmed in the second year of research, enabling the identification of some design patterns. However, pattern evaluators criticized the inconsistent way in which I articulated the underlying intercultural issues that these patterns aimed to address. The theoretically-informed, deductive research method used in the third year provided more consistency in articulating patterns. It focused on finding solutions to resolve communication breakdowns. Cross-cultural value dimensions provided background insight into why

**Table 3. Research phase year 3.**

Team composition	Method		Identification	Findings
	Data gathering	Analysis	Breakdowns/problems	Design Solutions
HK-Korea (major). (for comparison) HK-Aus (minor) and HK-Tai (minor).	Observations and interviews collection of transcripts of e-mail, yahoo group, documents and HK-Korean chats.	Computer-supported deductive qualitative content analysis using summative, sociological, pattern and latent coding. Coding scheme derived from previous analysis and theories of cross-cultural communication. Mapping of codes in network diagrams.	5 main categories for collaboration support: social awareness, contextual communication, community, coordination, specified contents, instructional authority and 11 design patterns.	
			<b>Grand opening:</b>	Organize a short intensive co-located workshop for collective community cultures in similar time zones.
			Initiate contact for collaboration.	
			<b>Community watch:</b>	Provide an online space as central resource for teamwork. This may bridge opposing cultural dimensions.
			Coordinate multiple virtual teams.	
			<b>International home:</b>	Converse based on design concepts and representation to link high and low contextual communicating cultures.
			Continuous production and exchange of ideas.	
			<b>Structured chat:</b>	Converse based on design concepts and representation to link high and low contextual communicating cultures.
			Provide a focus in synchronous negotiations.	
			<b>Summing up:</b>	Support creation of discussion summaries to connect high and low contextual communication cultures.
			Communicate discussion contents to all.	
			<b>Mood of the moment:</b>	Support textual conversation with visual means supporting high contextual and affective communicating cultures.
			Convey mood and emotions in conversations.	
<b>Annotated design gallery:</b>	Offer annotated design representation to share and bridge high and low contextual content specification.			
Reduce ambiguity of visual designs.				
<b>Who when what:</b>	Allow content management based on multiple criteria to balance several opposing cultural value dimensions.			
Information structure for diverse cultures.				
<b>Local variations:</b>	Implement local variations of shared design concepts to balance universal and particular standard cultures.			
Emergence of shared design ideas and concepts.				
<b>Global resolution:</b>	Organize distributed tutorials with local and remote tutors to support hierarchical authority cultures.			
Resolve conflicting local instructions.				
<b>Grand Finale:</b>	Organize virtually mediated final presentation to support collective community and hierarchical cultures.			
Resolve conflicting local instructions.				

some solutions work well in certain cultural contexts. However, in the comparison of data sets, solutions to overcome these problems were not always universally applicable.

## Findings - Design Patterns Network

In developing international collaborative learning environments learning design, team management and social interaction need careful consideration. One could compare the proposed design pattern network to a design system such as a service design, where each single element (design pattern) contains a mix of socio-technical components (i.e. technology, team management and tutoring, and social interaction). Not all of these components are considered equally in a design pattern. Some patterns focus more on technological designs and others enforce more social mechanisms, team management and tutoring.

Figure 5 shows a collection of 11 related design patterns and 7 pattern hypotheses emerging from this research. A pattern hypothesis is only partially articulated and not yet evaluated. Usually, a pattern collection evolves over years. Pattern hypotheses offer beginnings for new patterns. All patterns and pattern hypotheses are organized in clusters around the collaboration support mechanisms that evolved in consistency with the findings from the first and second year of analysis, these including ‘Community Coordination’, ‘Social Awareness’, ‘Contextual Communication’, ‘Shared Contents and Local

Implementation’ and ‘Instructional Authority’. The concepts in these clusters also had high code frequencies in the third year of analysis, making them central to the development of the pattern collection. For example, patterns grouped around the concepts of ‘Instructional Authority’ mainly related to the code *Instruction* and *Equal* or *Hierarchical Authority Orientation*. Prominent codes were chosen to cluster design patterns in meaningful groups. The arrows indicate the relationships between patterns. Some relationships are stronger than others. I indicate this through line width, some lines being bidirectional. The strength of relations between patterns could also be observed in the co-coding frequencies among codes.

The length of a single paper does not allow me to fully explain all 11 patterns; detailed design patterns and emerging pattern hypotheses can be accessed online at <http://crossculturalcollaboration.pbwiki.com>. Table 4 summarises all design patterns and indicates pattern relationships and applicability. Patterns are numbered for easy orientation. References to cultural dimensions, introduced in the Background section, are highlighted in italic font.

## Discussion of Patterns

A pattern is self-contained, but the above summary of a pattern collection aims to give an overview of related solutions for supporting design collaboration across national and geographical

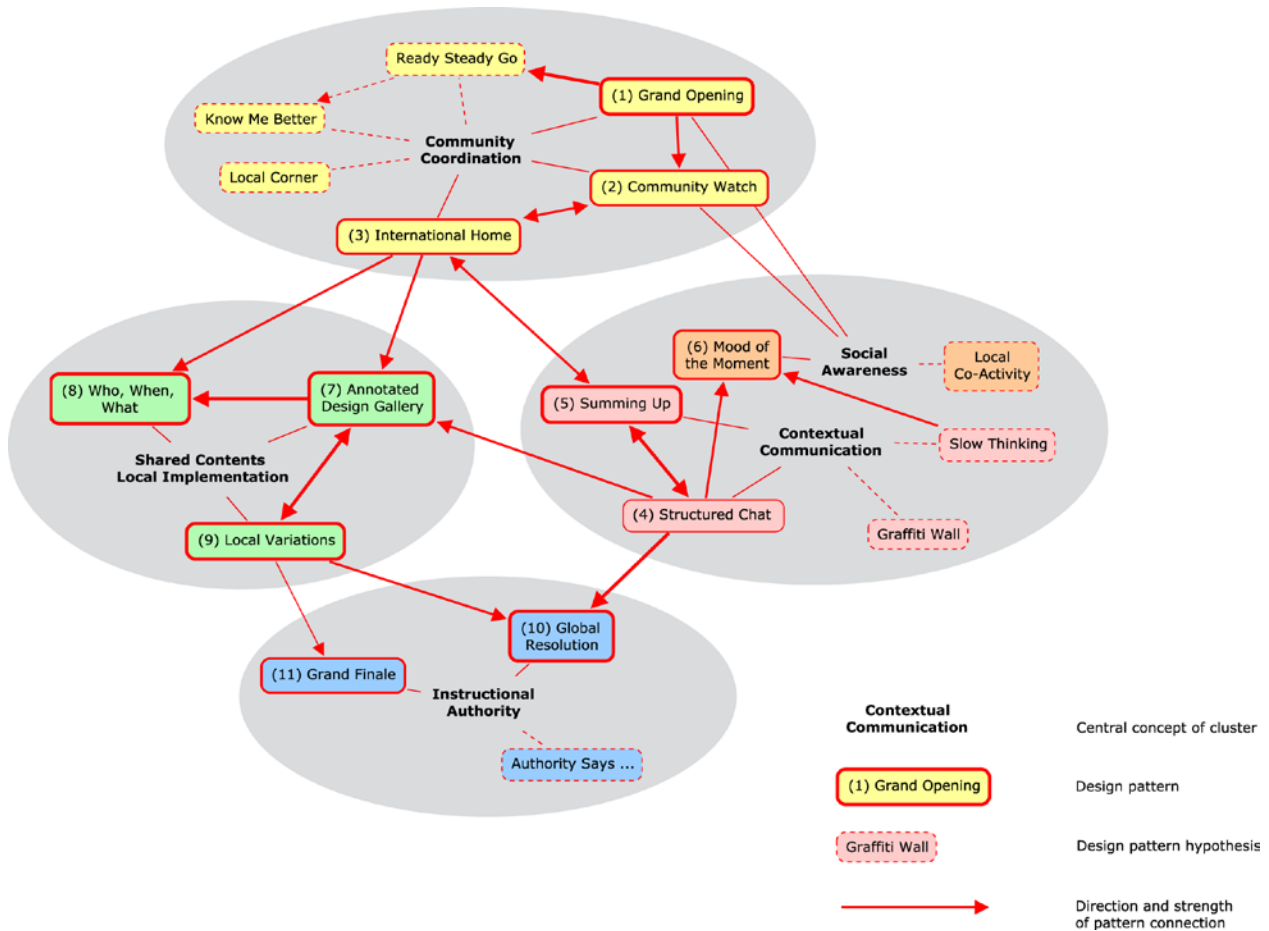


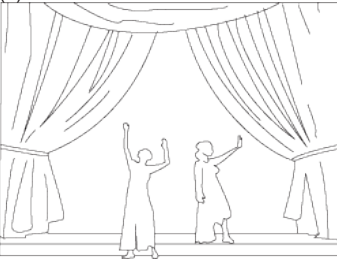
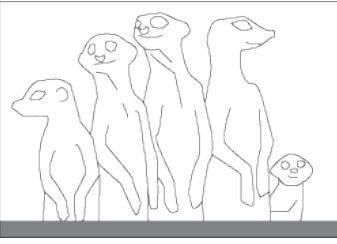
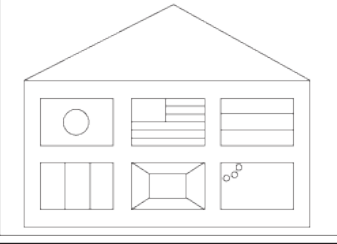
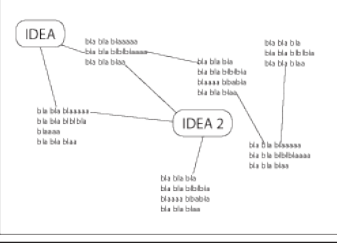
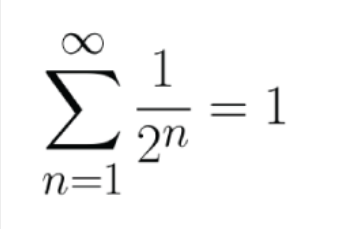
Figure 5. Network diagram of the pattern collection for cross-cultural collaborative design learning.



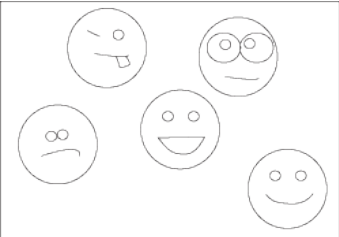
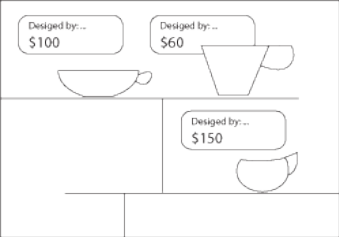
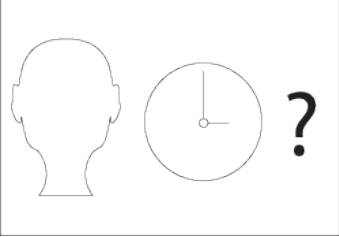
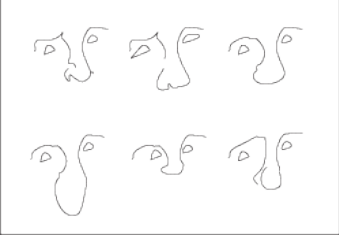


borders. As indicated, not all patterns are equally successful in all cross-cultural contexts. Patterns were similarly effective in Hong Kong/Korean and Hong Kong/Taiwanese collaborations, with the exception of INTERNATIONAL HOME and COMMUNITY WATCH. Conversely, several design patterns for the Hong Kong/Korean or the Taiwanese collaborations, such as GLOBAL RESOLUTION, proved to be less effective for the Hong Kong/Austrian teams. Some design patterns seem to be universally applicable.

Figure 6 indicates each culture’s value orientations as observed in the study. These observations partly align with the literature, but in some cases the value orientation slightly deviates from the expected orientation due to changing contextual factors. For example, in some cases the *Short Time Orientation* of a non-Hong Kong tutor overwrote the *Long Time Orientation inherent* in Hong Kong students, such as with the timing of assignments. Orange cells in Figure 6 indicate this ‘bipolarity’. Time zone differences are also indicated.

**Table 4. Eleven design patterns for cross-cultural collaboration.** HK/K stand for Hong Kong/Korean, HK/T for Hong Kong/Taiwanese and Hong Kong/Austrian collaboration respectively. White font with blue color signifies the cultural context in which it is applicable.

Name and Illustration	Summary	Applied
<p>(1) GRAND OPENING</p> 	<p>It is the students' first experience to collaborate with other nations and over a distance. The question is how you initiate contact so that students develop trust. An initial, face-to-face meeting allows participants to get to know each other and starts off the design project. It is important for Collective Community Orientation cultures to establish a feeling for community. A community can further grow using COMMUNITY WATCH.</p>	<p>HK/K HK/T HK/A</p>
<p>(2) COMMUNITY WATCH</p> 	<p>You need to strengthen the evolving community and wonder how to coordinate multiple global virtual learning teams working on similar design projects. An ongoing co-located workshop is not viable. You can coordinate community activities through a public accessible online community portal. Hierarchical Authority Orientation cultures will feel well managed by the tutors if relevant information is regularly updated. Via the portal students also access their INTERNATIONAL HOME.</p>	<p>HK/K HK/T HK/A</p>
<p>(3) INTERNATIONAL HOME</p> 	<p>The community is becoming established and international teams have been formed. The students' work on the design project intensifies. How do you facilitate the continuous exchange of design ideas? An online group space facilitates the storage, creation, and communication of design ideas. The possibility of asynchronous access to this space supports linear and parallel work habits of Monochronic and Polychronic Time Orientation cultures respectively. The group space also provides an ANNOTATED DESIGN GALLERY and STRUCTURED CHAT conversations are SUMMED UP and kept here.</p>	<p>HK/K HK/T HK/A</p>
<p>(4) STRUCTURED CHAT</p> 	<p>Asynchronous communication is supported in INTERNATIONAL HOME. Students need to synchronously discuss and clarify ideas. How do you provide a focus for negotiation in synchronous textual discussions? You structure discussions around shared design representations. Present local designs first, discuss variations and then find common design goals. High Contextual Communication (i.e. based on representations) supports textual communication. Such representations are stored in ANNOTATED DESIGN GALLERY. You can SUM UP conversations and store in INTERNATIONAL HOME.</p>	<p>HK/K HK/T HK/A</p>
<p>(5) SUMMING UP</p> 	<p>You have given synchronous discussions a structure that students can comply with, but how do you share these local or online chat discussions that only involve a few participants with all other distributed team members? Students are asked to summarize their conversations from online meetings and local tutorials. Summaries of High Contextual conversations explicitly review the shared understanding of distributed remote teams using Low Contextual Communication. INTERNATIONAL HOME stores summaries.</p>	<p>HK/K HK/T HK/A</p>

**Table 4. Eleven design patterns for cross-cultural collaboration (continued).**

Name and Illustration	Summary	Applied
<p>(6) MOOD OF THE MOMENT</p> 	<p>Structured discussions sustain rational decision-making. How can you convey mood and emotions in distributed intercultural communication? Offer a choice of visual communication means such as graphical icons or text formatting tools to support awareness of emotional values in a textually-mediated statement. Visually-mediated, indirect communication is considered more polite in Collectivistic Community, Affective Relation, and High Contextual Communication Orientation cultures.</p>	<p>HK/K HK/T HK/A</p>
<p>(7) ANNOTATED DESIGN GALLERY</p> 	<p>Students make extensive use of design representations to communicate ideas over a distance. How can you reduce ambiguity in interpretation of visual design representations? Offer a picture sharing facility and motivate students to annotate digital representations of local artefacts. Summaries of the meaning of design representations or ideas in textual annotations bridge communication preferences of High and Low Contextual Communication Orientation cultures. This gallery stores LOCAL VARIATIONS. You can use WHO WHEN WHAT to organize representations of such variations.</p>	<p>HK/K HK/T HK/A</p>
<p>(8) WHO WHEN WHAT</p> 	<p>Students might have different needs and preferences according to which information is displayed. How do you create a content structure that accommodates multiple culturally diverse groups? Give users the ability to manage content according to at least three criteria 1 User ID, 2 Date and Time, and 3 Content Summary. Although Low Contextual Communication Orientation cultures can view activity in explicit categories, High Contextual Communication Orientation cultures are comfortable with complex information architectures to monitor and get a feeling of the entire activity space.</p>	<p>HK/K HK/T HK/A</p>
<p>(9) LOCAL VARIATIONS</p> 	<p>Students work in parallel local design teams. They are required to reach a shared design idea, which can be implemented in the final design. How can you promote the development of shared design solutions? Support the implementation of local variations of globally shared design concepts at any level of fidelity and stage of the design process. Shared understanding among students is gained through multi-modal, High and Low Contextual Communication of design variations. They are displayed in the ANNOTATED DESIGN GALLERY. Use STRUCTURED CHAT to discuss local designs and SUM UP roles and responsibilities for producing such implementations.</p>	<p>HK/K HK/T HK/A</p>
<p>(10) GLOBAL RESOLUTION</p> 	<p>Local tutors mainly instruct local teams. How can you support the global virtual team to coordinate and resolve any conflicting local instructions? Let local instructors advise not only local teams, but also global virtual teams in video-mediated online tutorials. Due to the strong Hierarchical Authority Orientation of the students, the advice is taken without objection. This resolves students' potential uncertainties and restores the harmony in Collectivistic Community Orientation cultures. You can use the pattern STRUCTURED CHAT to achieve GLOBAL RESOLUTION.</p>	<p>HK/K HK/T HK/A</p>
<p>(11) GRAND FINALE</p> 	<p>The global virtual team is required to present the final design and LOCAL VARIATIONS in unity. How can one achieve a fair evaluation of the global and local teamwork and conclude the international collaborative design project satisfactorily? Organize a technologically sophisticated, virtually-mediated final presentation where teams receive a final critique and evaluation of their work. Students have a final chance to demonstrate technological and organizational competence. A Collectivistic Community Orientation in students motivates them to present collectively. High and Low Contextual Communication Orientations are balanced in the presentation.</p>	<p>HK/K HK/T HK/A</p>

**Note:** HK/K stand for Hong Kong/Korean, HK/T for Hong Kong/Taiwanese and Hong Kong/Austrian collaboration respectively. White font with blue color signifies the cultural context in which it is applicable.

	Activity		Authority		Commun.		Context		Relation		Principle		Time		Techno.		Uncert.A.		T.Zone			
	Ach.	Asc.	Hier.	Equ.	Ind.	Coll.	Low	High	Neu.	Aff.	Univ.	Part.	Long	Short	Mon.	Poly.	We	Us	Low	High	GMT	Diff.
HK																					+8	0h
T																					+8	0h
K																					+9	1h
AUS																					+2	6h

**Figure 6. Cultural value orientations in Hong Kong, Korea and Austria drawn from literature and observed in this study.**  
The coloured boxes represent the cultures' tendencies, not absolute values.

I want to start a case-by-case comparison with the first pattern in this collection, GRAND OPENING. The success of this solution during the Hong Kong/Taiwanese teamwork can be explained by a comparatively similar collaboration context to Hong Kong/Korea. In both cases, *Collective Community* and *Hierarchical Authority Orientations* prevail. GRAND OPENING was not used in the Hong Kong/Austrian collaboration. A mixed *Individual* and *Collective Community* and *Equal* and *Hierarchical Authority Orientations* in students might have contributed to this solution being disregarded. Geographic or temporal dispersion and monetary limitations mainly explain why this pattern was not used in this case. This can be supported by related research on international collaboration, which shows that starting a remote collaborative project co-locatedly established trust among team members and improved communication among Hong Kong and Dutch students (Vogel, van Genuchten, Lou, Verveen, van Eekhout, & Adams, 2001; Rutkowski, Vogel, Bemelmans, & van Genuchten, 2002).

The second pattern, COMMUNITY WATCH, was only successful in the Hong Kong/Korean collaboration. Surprisingly, Hong Kong/Taiwanese teams did not engage in COMMUNITY WATCH. A possible explanation is that Hong Kong and Taiwan share very similar views on socializing and working, more similar than Hong Kong and Korea. Community activities were coordinated through locally and remotely co-present community members in daily synchronous communication. Hence, a shared *Collective Community*, *Hierarchical Authority Orientation* supports community coordination, but watching parallel teams' activities asynchronously is not the only solution to this problem. Due to similarities in *Polychronic Time* and *High Contextual Communication Orientations* between Hong Kong and Taiwanese teams, students seemed to have favored communicative over instrumental coordination. In the Hong Kong/Austrian collaboration, the lack of success of COMMUNITY WATCH might be partially attributed to the pattern GRAND OPENING not being used. In related research, Bennett and Salmon (2005) report the successful coordination of an international design learning community through the online Omnium platform that links team spaces and community assets such as design briefs, galleries and lectures. This suggests that COMMUNITY WATCH might be successful in other collaborative settings.

The third pattern, INTERNATIONAL HOME, was successfully employed in the Hong Kong/Korean and the Hong Kong/Austrian collaboration. A reason for this phenomenon might be the large geographical and time distance, which complicated synchronous, communicative coordination. Another reason might be Austrians' lower *Individualism*, but higher *Uncertainty*

*Avoidance* behaviour than Hong Kong, which makes coordinating local activities through an asynchronous online space much more likely to be successful. In addition, Austrian students also showed a more *Monochronic Time* orientation, suggesting a linear progression of designing collaboratively. These two conditions can be supported by a shared team space, which offers control over ambiguous remote activities and captures the design process linearly, as it progresses. Comparing the Hong Kong/Korean and Hong Kong/Taiwanese team coordination leads to another astonishing result. Since Hong Kong and Taiwanese students met on a daily basis for synchronous communication conducted in English and Chinese, local activities were coordinated instantly and synchronously. Moreover, this regularity meant instrumental coordination through modifications of shared design representations was possible on a synchronous basis. Using an asynchronous team space to store and share artifacts was less successful in the Hong Kong/Taiwanese collaboration. Students preferred synchronous online communication (STRUCTURED CHAT) to the asynchronous communication provided in the INTERNATIONAL HOME.

The fourth design pattern, STRUCTURED CHAT, was used by the Hong Kong/Korean and Taiwanese teams. These teams shared the same patterns of cultural orientation, *Collective Community*, *High Contextual Communication*, which made communication structured around local design artefacts more viable. Unfortunately, data to facilitate a comparative analysis of the Hong Kong/Austrian use of structure in synchronous conversation is not available. In related studies on collaborative learning, researchers suggest conversation categories or guiding questions to structure conversations to reduce ambiguities (Lonchamp, 2005). However, this research suggests that local design artefacts and shared representations effectively guide design collaboration, at least in the Hong Kong/Korean and Taiwanese learning teams.

SUMMING UP was used in Hong Kong/Korean and Taiwanese collaboration. Teams showed a very similar pattern in summarizing online or local conversations. This similarity might be the result of the similar cultural value orientation of Hong Kong and Taiwanese students, which combines *Collective Community*, *Hierarchical Authority* and also *High Contextual Communication Orientations*. Those students engage in indirect and lengthy dialogues, which enable intermediate or final summaries of the dialogue. Although, Hong Kong/Austrian teams less frequently encountered the problem of unfocused communication, they also summarized conversations. Due to a *Low Contextual Communication Orientation*, frequent summaries seemed to occur naturally on the part of Austrian students. It might be that

the *Collective Community Orientation* of Hong Kong students encouraged them to follow suit to keep the harmony in the team and avoid direct conflicts.

MOOD OF THE MOMENT was used in Hong Kong/Korean and Taiwanese teams. Similar conditions in cultural value orientations such as *Affective Relation* and *High Contextual Communication Orientation* in these teams might have encouraged this solution. It was more difficult to compare the success of the Hong Kong and Austrian students' affective communication. Over the two years of observation, some students used emoticons to communicate, but others did not. This ambivalence might be attributed to the mixed orientations captured in the cultural context. Although Austrian students differ from Hong Kong students in their *Community* and *Contextual Communication Orientations*, *Affective* and *Neutral Relations* seemed to be bridged in some instances in the Hong Kong/Austrian collaboration. In this case, a simple comparison is not very effective in identifying the success of conveying mood in communication between Austrian and Hong Kong students. More research is needed to confirm or discount this finding. Lukosch and Schümmer (2006) reported on a similar pattern called DIGITAL EMOTIONS in computer-supported collaboration. However, the author's research cannot confirm the success of such a design pattern in all intercultural collaboration contexts.

The seventh pattern, ANNOTATED DESIGN GALLERY, might be considered a valid interaction design solution to computer-supported collaboration in design between designers in different nations. Due to the combination of multi-modal communication and feedback on shared content, this research revealed a successful communication of design ideas in all cultural contexts studied. This pattern seems to balance opposing cultural dimensions such as *High* and *Low Context Communication Orientations*. It is also supported by research into collaborative work patterns; Schümmer (2004) identifies two separate solutions — SHARED ANNOTATION and ARTIFACT REPOSITORY — to support distributed teams in artifact-centered communication.

The eighth design pattern, WHO WHEN WHAT, persists across various nations in collaboration. The pattern bridges a variety of opposing cultural value orientations through the inclusion of multi-faceted information about the content, such as the person who created the content, this being important for *Equal* and *Hierarchical Authority* cultures. In addition, *Monochronic Time* cultures might structure content according to the date and time of creation, which is recognized by this pattern. *Collective Community* cultures often structure information based on a network of related content given as part of the solution in this pattern. This pattern aligns with the "Five Hat Racks" design principle for organizing information (Lidwell, 2003).

The practice of implementing LOCAL VARIATIONS based on shared concepts was used in similar ways in the Hong Kong/Korean and Hong Kong/Taiwanese collaborations. This might be attributed to a shared *Collective Community Orientation* in both cultures. The Hong Kong/Austrian collaboration did not use this pattern. Austrian students represent an *Individual Community* culture that can accept parallel and competing design ideas. Those competing, locally implemented ideas were not necessarily

based on globally shared concepts. Conflicting concepts were appreciated. Compromises were not necessary. In this context, Hong Kong students accepted a parallel idea development as part of this particular collaboration process based on a *Collective Community Orientation* (keeping the harmony in the team) and *Hierarchical Authority Orientation*, with tutors encouraging parallel developments. This pattern shows the importance of subtle differentiations in supporting collaborative design learning across cultures. Although it might seem that students of all nations used LOCAL VARIATIONS, a closer examination reveals that the Hong Kong/Korean and Hong Kong/Taiwanese implementations are based on shared ideas, while the Hong Kong/Austrian implementations are based on competing ideas.

The tenth design pattern, GLOBAL RESOLUTION was used in the Hong Kong/Korean and Hong Kong/Taiwanese collaboration, perhaps due to a similar cultural value orientation. Local students with *Hierarchical Authority Orientation* follow local tutors' advice, but the global team cannot always resolve differing advice from local tutors. The collective instruction of the Hong Kong and Korean or Taiwanese tutors resolved such breakdown based on the instant acceptance of *Hierarchical Authority* instructions negotiated by both cultures' tutors. In comparison, the Hong Kong/Austrian collaborations were not instructed through GLOBAL RESOLUTIONS. This might be due to the *Individualistic Community* and *Equal Authority Orientation* in Austrian culture. Moreover, larger time differences complicated the synchronous communication between the Hong Kong and Austrian students and teachers. However, if GLOBAL RESOLUTION sessions were effective means of instruction, they could have been arranged as the following pattern GRAND FINALE shows.

A GRAND FINALE presentation was used across cultures in distance collaboration. Once again, the comparison of the Hong Kong/Korean and Hong Kong/Taiwanese learning teams suggests that the shared *Collective Community* and *Hierarchical Authority orientation* influenced teams to present themselves to others as a collective team and community. The *Hierarchical Authority Orientation* influenced the subordination of team goals to the project brief, which required showing the common results of teamwork. Although the Hong Kong/Austrian teams had a different cultural orientation than the Hong Kong/Korean teams, they still had successful final presentations. One possible explanation for these results is the format of the joint final networked presentation that bridges *Ascription* and *Achievement-oriented* cultures. If the presentation runs smoothly and the local implementations are well done, *Ascription* cultures feel acknowledged for their work and *Achievement* cultures hope for a better grade. A final design critique seems to be an element that bridges design collaboration across various cultures, confirming findings by Sheldon (1995) and Kvan (2001).

## Conclusion and Further Research

This research developed several patterns for supporting the design of interactive learning environments for cross-cultural collaboration. The findings suggest that interaction design



solutions for supporting collaborative activities differ across cultures. The research shows that even when many aspects of cultural orientation are similar, as for example, among the Asian cultures, subtle differentiations of cultural orientations require the use of different solutions to support collaboration. This was seen in the pattern INTERNATIONAL HOME, which was less successful in the Hong Kong/Taiwanese collaboration than one would expect. On the other hand, the research identified solutions that apparently can be universally applied, such as ANNOTATED DESIGN GALLERY, WHO WHEN WHAT and GRAND FINALE. Further evaluations of the applicability of these universal and other patterns will be carried out in the context of the development of a collaborative online design studio at the Open University.

The comparison of patterns has shown that solutions should not be seen in isolation. For example, there was a relationship between the failure to establish a learning community using GRAND OPENING and the failure to maintain this community online using COMMUNITY WATCH in the Hong Kong/Austrian collaboration. Designers of complex socio-technical systems such as collaborative learning environments need to take on a holistic view in design to support those environments through a collection of related patterns. Designers also need to know in which context certain solutions are most appropriate. For example, using the patterns collection presented above showed that a collaboration support system for the Hong Kong/Taiwanese design teams included a face-to-face kick off meeting, extensive synchronous communication support and virtual group tutorials. A collaborative environment in the Hong Kong/Austrian collaboration would look very different, including extensive asynchronous communication support, virtual group homes and probably even local team homes. This collection suggests possible support for other nations, but I would recommend caution in doing so, my research showing how seemingly small differences in cultural values across nations can still require different collaboration support.

This opens up the question of ‘generalizability’ of design patterns. Again, I want to establish the comparison between a design pattern collection and a design system, such as a service design. For example, no designer would export a design for a city transport system from one country to another without anticipating substantial changes in the service design. Adjustments in language are required and designers need to address more subtle questions like passenger flow, expectations of how and where to buy tickets, which jobs machines can take on instead of humans and so forth. These issues stem from differences in cultural values and expectations. In the same way as designers might be able to learn from successful solutions elsewhere, they still need to employ their design intelligence and cultural understanding to adapt designs to local needs and preferences. A design pattern is no formula for guaranteed design success, rather they are meant to inspire discussions in design and development teams. The proposed design patterns discussed in this paper aim at building awareness of potential cultural differences that need to be addressed in designing complex systems such as international collaborative learning environments. These patterns may also help in constructing prototypes to test ideas in another culture.

The field of design patterns research is relatively young and contentious. There are many opportunities for further research. As Alexander (1977) stated, “patterns are alive and evolving” (p. xv). Ideally, the current design pattern collection should be compared in as many cross-cultural learning situations as possible to gain a better understanding of specific needs across cultures and to extend the collection. Often design patterns evolve in community settings that allow the merging of knowledge of diverse backgrounds and experiences into design patterns. This research is a first step to invite scholars and professionals to compare the presented design patterns to other international collaborative learning situations. Research is ongoing and all results cannot be presented in a single journal paper. There are some tentative design patterns in the collection, such as KNOW ME BETTER, that seem to recur in other collaboration contexts, but are not yet fully articulated. These patterns should be explored further. Not all problems in collaboration relate to national cultural differences. Pattern-interested scholars and professionals should continue to critically discuss the use of cultural value dimensions in design patterns. In some cases, cultural dimensions are not sufficient to explain my observations. Further research is needed to investigate how far theoretical underpinnings and explicit references to theory might improve or reduce the use of patterns. Hopefully, a community evaluation will support the development and growth of this pattern collection. Community ownership and development of patterns will lead to their diffusion and wider use.

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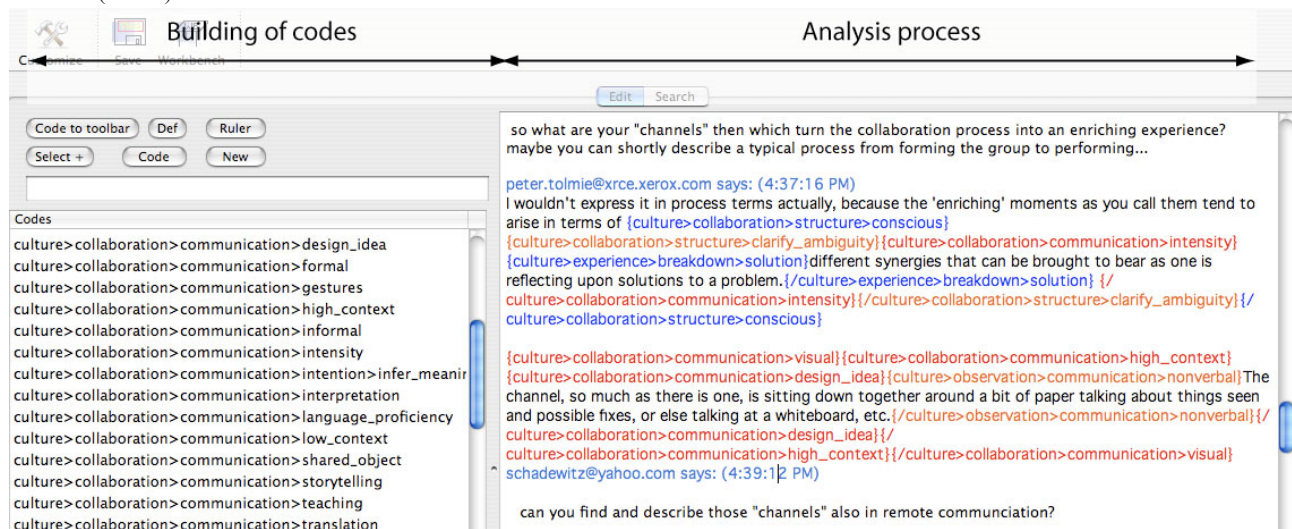
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## Appendix A

The first observations and interviews with students were analyzed thematically to gain a general overview of issues occurring in remote international collaboration. This was then supported by an analysis of recurring patterns in expert interviews using computer analysis software (below).



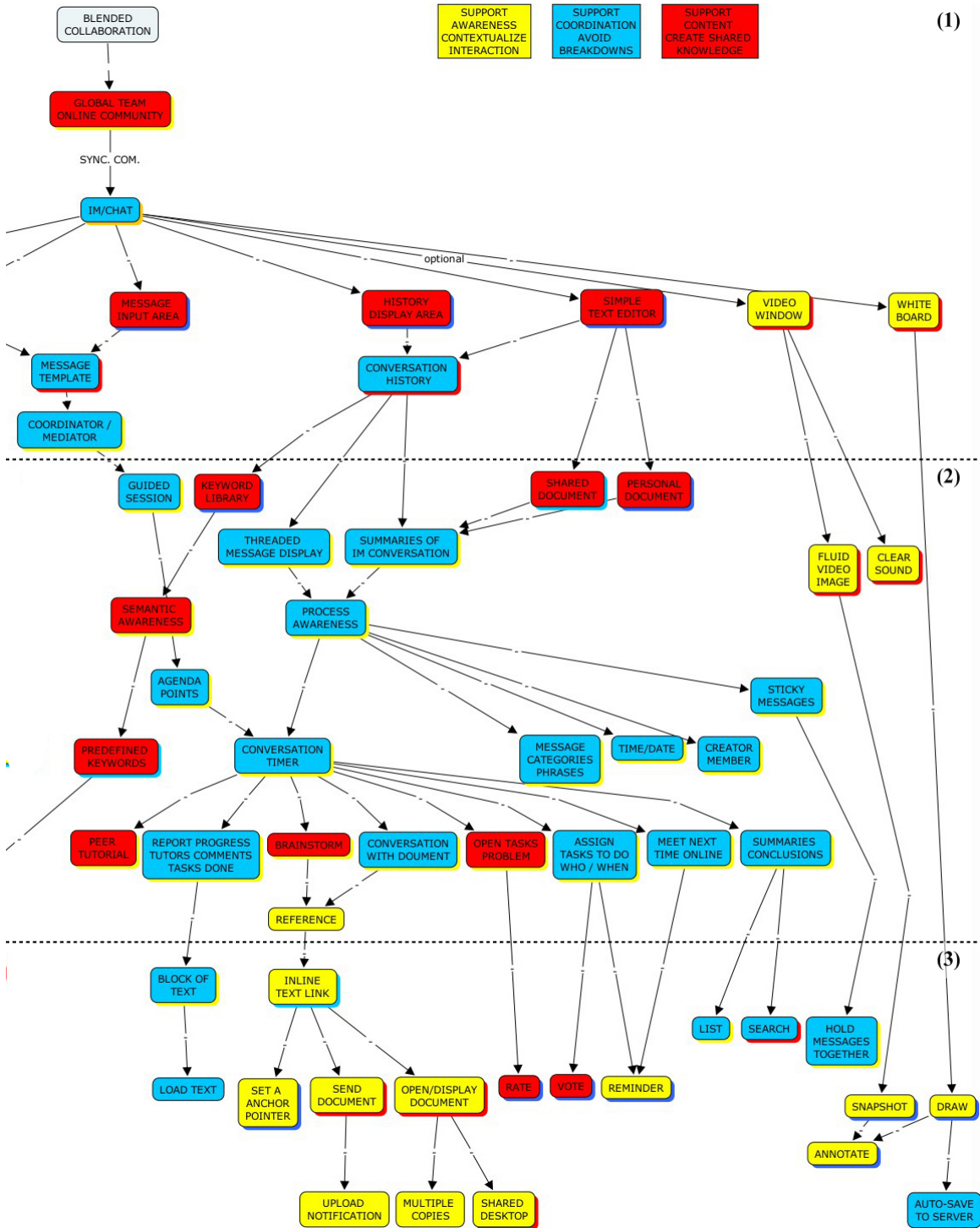
The selection of codes and frequencies below shows a categorization of occurrences into Breakdowns, Communication, Tools, and Coordination. First indications for the pattern GLOBAL RESOLUTION already occurred in the first year (i.e. blue highlighted codes), but could not be fully articulated until the third year.

Breakdown		Communication		Tools		Coordination	
solution	58	design_idea	70	synchronous	24	methods	39
unknown_reason	30	high_context	46	asynchronous	21	workflow	34
language_use	24	intensity	29	coordination	10	scheduling	20
individualist	13	shared_object	23	communication	9	clarify_ambiguity	20
expectation	11	informal	20	content	9	intention	12
language_proficiency	11	interpretation	17	specialized	6	technology	12
different_profession	10	visual	16			uncertain	11
Timing	10	language_proficiency	13			conscious	9
no_explicit_rules	9	formal	11				



## Appendix B

Relationships among observations in the second year were explored by mapping them into a hierarchical network diagram (a part shown below). The observations were structured by interaction (1) Goal, Experience, Tools and Concepts in the upper level, (2) Strategy and Indicator in the middle, and (3) Task and Action (passive, active) on the lower level. Observations of video-supported tutorials were made (far right in diagram), but not articulated into preliminary design patterns.

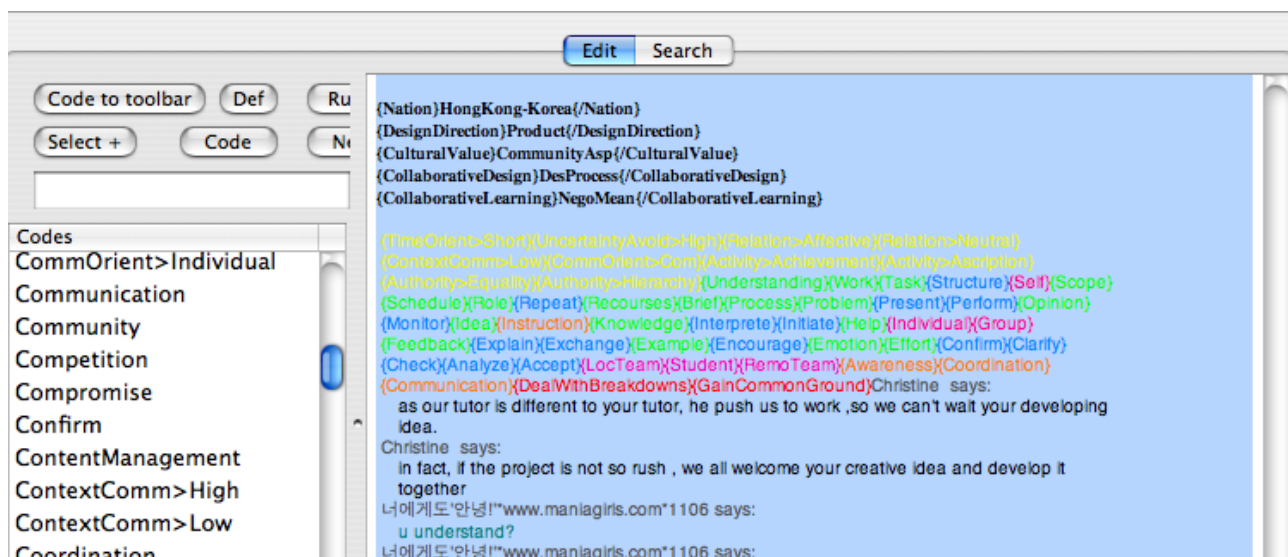




## Appendix C

Goal	Method	Cross-cultural Collaboration	Collaborative Design	Collaborative Learning
Breakdown	Awareness	ActivOrient	DesIdea	ShareAthmo
DealWithBreakdown	Communication	AffectNeutral	DesImpl	ShareInfo
GainCommonGround	ContentManagement	AuthConcept	DesGoal	CompareInfo
		Coordination	CommunityAsp	DiscoDisson
	Implementation	ContexComm	DesProcess	NegoMeaning
	Instruction	ParticularUniversal	DesRepres	RestructKnowl
		Technology	DesScope	CoConstKnowl
		TimeOrient	DesSolution	TestSynth
	UncertAvoidance		DesSpace	ApplyNewKnowl
			DesTask	IntructTut
			NoDesign	IntructLec
			Assessment	
			PresentResult	

In the third year, the coding scheme (above) was informed by theoretical constructs known from cross-cultural communication and collaborative design learning. In the computer-supported coding process communication protocols were coded with above codes.



Based on this coding process, code and co-coding frequencies could be determined. The illustration below shows selected co-coding frequencies that helped to recognize dominant relations between the code Instruction and other codes. This led to articulating the design pattern GLOBAL RESOLUTION.

Global Resolution	Activity>Achievement	Assign	Authority>Hierarchy	Awareness	Breakdown	Clarity	CommOrient>Collect	ContextComm>High	ContextComm>Low	DealWithBreakdowns	Explain	GainCommonGround	Implementation	Process	Reference	Representation
LocTeam	461	197	247	803	575	656	607	521	581	547	451	709	452	693	560	521
RemoTeam	443	182	235	785	556	646	588	505	561	539	444	682	446	674	553	508
Instruction	134	116	149	161	146	147	133	90	143	127	113	133	116	163	114	105
LocInstructor	89	56	99	96	89	91	74	68	79	68	70	87	64	94	67	61
RemoInstructor	50	43	77	72	73	70	62	45	61	55	50	69	39	74	45	54