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ABSTRACT

An ethnographic study conducted in Hong Kong investigated commonalities in Chinese and English that might be used to elicit prior learning in the first language to enhance learning in English as a Second Language (ESL), for both language and content area instruction. Specifically, it: (1) examined Hong Kong students' exposure to and interaction with graphic representation of knowledge structures (illustrations and format of textbooks and other instructional materials); (2) determined the students' academic graphic literacy, or familiarity with the conventions of and ability to construct meaning from that graphic representation; and (3) suggested means of using common graphic representations and graphic literacy to elicit prior learning. Subjects were 450 students in 3 different types of schools. All were observed, and 13 were interviewed. It is concluded that Hong Kong students encounter many of the knowledge structures in graphic form in their education, and that many graphic forms and textbook illustrations are common across languages. The students showed a high level of graphic literacy, and demonstrated awareness of different graphic representations, interaction with graphics, ability to construct meaning from different graphic forms, and understanding of graphic representations of knowledge structures presented in English. Implications for ESL and content instruction are outlined. (MSE)

ACADEMIC GRAPHIC LITERACY ACROSS LANGUAGES AND CULTURES: A STUDY OF HONG KONG STUDENTS

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by

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PURPOSE OF THE STUDY

This paper reports on some of the findings of an ethnographic study conducted in Hong Kong (HK). It is part of a larger study designed to bring about equity of opportunity for Pacific Rim English as a second language (ESL) students who have to learn English and content-area subject matter in English. The purpose of the study was to discover commonalities across two languages which might be used to elicit ESL students' prior knowledge learned in their first language (L1) and to make suggestions for using these commonalities to enhance student learning of language and content. More specifically, it sought (1) to discover HK students' exposure to and interaction with graphic representation of knowledge structures; (2) to establish HK students' academic graphic literacy; and, (3) to suggest means of using common graphic representations of knowledge structures and students' graphic literacy to elicit ESL students' prior knowledge learned in their L1 and, thus, to enhance student acquisition of a second language and learning of content.

UNDERLYING ASSUMPTIONS

Research suggests that ESL students take upwards of five years (Cummins, 1984; Collier 1987) to reach proficiency in school or academic language comparable to their English-speaking counterparts. The implication of these research findings is that ESL students are denied the full benefits of education and full access to school knowledge in schools in North America because content-area knowledge is presented in English. What can we do to enable ESL students to learn content-area knowledge and acquire English language proficiency simultaneously?

Prior Knowledge

The role of prior knowledge (Swales, 1990) in language comprehension which has been formalized as schema theory (Bartlett, 1932; Carrell & Eisterhold, 1988), and the concept that background knowledge constitutes the foundation for students' future learning is increasingly being recognized. For immigrant and overseas students who join the school system of an English-speaking country for the first time, background knowledge is defined as the sum total of the experiences, both formal schemata and content schemata (Carrell, 1983), they bring with them from their home country, experiences acquired both in their first language, e.g., Chinese, and in English. While some content schemata may be culture-specific and thus fail to exist for L2 learners (Carrell & Eisterhold, 1988), according to the linguistic interdependence principle, there is also a common underlying proficiency which makes possible the transfer of academic or literacy-related skills across languages (Cummins, 1989). It is agreed that teachers can, and should, make use of students' prior experiences to facilitate student learning of new knowledge. How can this be effected? In other words, how can teachers whose language of instruction is English elicit ESL students' prior knowledge acquired in their L1, e.g., Chinese? Are there specific commonalities across languages/cultures which can be used to elicit students' background knowledge and academic or literacy-related skills learned in another language.

The Knowledge Framework

According to Mohan (1986), there are certain knowledge structures which appear across subject areas, and across modes of communication. They include classification, principles, and evaluation, which are categories of general, theoretical knowledge; and,

description, temporal sequence, and choice which are categories of specific, practical knowledge. These knowledge structures are reflected in the top-level or macro-structure of written text, they are represented in oral discourse, and they can also be expressed in graphic form. They are the written, spoken or graphic representations of thought structures, such as classifying, relating cause-effect, evaluating, describing, temporal sequencing and decision-making, which, I argue, are underlying proficiency skills which are common across languages and cultures. If these knowledge structures are common across languages, their graphic representations should be able to elicit students' prior knowledge learned in their L1. To establish the efficacy of graphic representation of knowledge structures as a tool for activating ESL students' prior knowledge, we have to find out (1) whether or not these thinking skills or knowledge structures in both verbal and graphic form exist in textbooks and instructional materials across languages; and (2) how well ESL students read and write graphics found in their L1 and how well they read graphics found in another language (English). To address these questions, I conducted a series of studies designed to discover the academic graphic literacy of students in Pacific Rim countries. The rest of this paper describes the first of the series of studies, an ethnographic study conducted in HK.

CONDUCT OF THE STUDY

The Cultural Setting

I went into the cultural setting of several secondary classrooms in three different schools in HK. Selection of students was based on judgmental sampling (Burgess, 1984) and accessibility. I was interested in lower secondary students who were likely to find themselves

in an English-speaking country as immigrants or overseas students. Three schools, examples of three different types of schools in HK, agreed to participate. Thus, form-one students in three secondary schools formed the participants of the study. The classes and number of students observed are shown in Figure 1.

Figure 1. Participants of the Ethnographic Study

NAME OF SCHOOL	School A	School B	School C
TYPE OF SCHOOL	Chinese middle school Co-ed	Anglo-Chinese Grammar Girls'	Anglo-Chinese Prevocational Boys & Girls in different classes
LANGUAGE OF INSTRUCTION	Chinese Chinese textbooks	Mixed code English textbooks	Chinese Chinese handout English textbooks
NO. OF CLASSES OBSERVED	1	5	5
NO. OF TEACHERS OBSERVED	10	7	10
NO. OF STUDENTS OBSERVED	40	210	200
SUBJECT DISCIPLINES OBSERVED	English Chinese Chinese History World History Geography Computer Science Mathematics Bible Mandarin	English Chinese Mathematics Geography History Religion	English Chinese Science Mathematics Retail Fashion Design Metal Work Electrical Office Practice
NO. OF STUDENTS INTERVIEWED	8		5

School A was a Chinese grammar middle school in which the students were taught English, Chinese, Mathematics, History, Geography, Science, Religion, Ethics, Music, Art and P.E. The language of instruction for all subjects except English language was Chinese (Cantonese) and the content textbooks were also written in Chinese. I followed the time table of a form-one class for two weeks.

School B was one of the elite Anglo-Chinese secondary girls' grammar schools in HK. In Anglo-Chinese schools, all content-area subjects were traditionally taught in English, with the exception of Chinese and Chinese History. In recent years, however, "the English proficiency level of many students is often inadequate to enable them to be taught exclusively in English... . Particularly in teaching content subjects, teachers consequently often switch back and forth between English and Chinese during lessons" (Richards, Tung & Ng 1991, p. 3). This "mixed code" (Richards et al., 1991) style of teaching was found in School B and English textbooks were used. All the five divisions, one of which was a remedial class, of form-one classes were observed.

School C was a co-educational prevocational school but boys and girls were put in different classes: boys read technical subjects such as Electrical and Metal work, while girls took commercial subjects, e.g., Fashion Design, Office Practice, and Retailing. The language of instruction was Chinese and some instructional materials were in Chinese but textbooks were English textbooks. According to the students themselves and their teachers, most of the students who opted, or were placed in, a prevocational school were usually among the lower achievers.

I observed a wide range of form-one students in terms of language proficiency,

achievement, and socio-economic background and a wide variety of content subjects, representing a considerable proportion of secondary ESL students teachers are likely to encounter in a secondary classroom in Canada. I should, however, add that this report is to be read with the understanding that the participants of the study are not a random sample of the population of HK students. Nevertheless, these are students likely to emigrate to an English-speaking country. If they do, they will find themselves in a situation in which they have to learn English and difficult content subject matter taught in English. The principals and teachers of these schools expressed their concern about the low English proficiency of the students. In order not to deprive these students of equal access to school knowledge presented in English, it is necessary to find ways to bridge their prior knowledge learned in their L1 and new knowledge to be learned in English.

Data Collection

I spent a total of 120 hours in the three schools. Data collection methodology includes classroom observation, group discussion with the students, interview with individual students to discover their interaction with graphics and their academic graphic literacy, and examination of documents, such as instructional materials, textbooks, and student assignments.

Research questions

The study was conducted to find out whether or not there are specific commonalities across two languages, i.e., English and Chinese, which can be used to elicit prior knowledge, more specifically to answer the following questions:

1. Are knowledge structures found in secondary content-area textbooks in HK?

2. Are graphic forms and conventions similar in HK and Canadian textbooks and instructional materials?
3. Did HK students encounter and interact with graphics in classroom tasks?
4. Did HK students know how to present knowledge in graphic form?
5. Could HK students interpret and construct meaning from graphics in instructional materials?
6. Could HK students interpret graphics presented in an unfamiliar language?
7. How did HK students construct meaning from graphics?

FINDINGS OF THE STUDY

The research questions are addressed in the following sections and the findings are reported under four headings (1) graphics in instructional materials; (2) graphics in classroom tasks; (3) students' academic graphic literacy; and (4) teaching/learning styles.

Graphics in Instructional Materials

Question 1. Are knowledge structures as defined by Mohan found in content-area textbooks used in HK?

Knowledge structures as defined by Mohan (1986) exist in Chinese content-area textbooks in both written texts and illustrations. The analysis of a unit of a Chinese social studies textbooks according to the Knowledge Framework found in Figure 2 the analysis of the illustrations of a section of the same book is found in Figure 3.

Figure 2. Analysis of a Chinese Social Studies Unit According to the Knowledge Framework

CLASSIFICATION	PRINCIPLES	EVALUATION
Definition of population Definition of density Classification of population by age, gender, nationality, religion Distribution of population by district: HK, Kowloon, New Territories Definition of census	Factors affecting population growth The need to live in harmony with people from other cultures: reasons The rise of satellite towns: causes and effects	Values: living in harmony Evaluation of the population density of different districts The value of census Attitudes towards census taking and the census period
Comparison of birth rate and death rate Comparison of population by gender Description of religions	Population growth in chronological order Census procedure	What can I do to help during the census period
DESCRIPTION	SEQUENCE	CHOICE

Figure 3. Analysis of the Illustrations in a
Chinese Social Studies Unit According to the Knowledge Framework

CLASSIFICATION	PRINCIPLES	EVALUATION
Graphic organizer of chapter Bar graph: classification of population by age group Bar graph: classification of population by nationality Chart: classification of population by district	Graph: factors affecting change in population	
Graph: increase in population Graph: comparing birth & death rate Bar graph: comparing male and female population Diagram: comparing population by age group Photos: describing landmarks, religion, etc. Chart: comparing population by district Pie chart: comparing population Map: comparing population density	Pictures: Census procedure Graph: Population from 1911 to 1991	
DESCRIPTION	SEQUENCE	CHOICE

Question 2. Are graphic forms and conventions similar in HK and Canadian textbooks and instructional materials?

I examined the illustrations of HK social studies textbooks and compared them to those in Canadian social studies textbooks at comparable grade level and discovered that

authors of illustrations use similar graphic forms and conventions, e.g., tree graphics, charts, the title, headings, top-down, left-right, etc. It should be noted that in Chinese-medium content-area textbooks, tables or charts are read left-to-right, but in only one subject discipline, Chinese Literature, tables and charts are read right-to-left. The functions of illustrations are also to a large extent similar. However, HK textbooks are more highly illustrated than Canadian textbooks. These findings are discussed in another paper (Tang, submitted for review). In form, the graphics are mostly representational pictures (Levie & Lentz, 1982), but there are line graphs, bar graphs, pie charts, classification trees, time lines, charts or tables and maps as well.

In short, the knowledge structures of description, sequence, choice, classification, principles, and evaluation in both written and graphic forms are common across Chinese and English. The findings are not surprising. Since knowledge structures are represented in the semantic relations of discourse, they belong to that level of mental representation at which information, in any form and language, is subject to the same kind of rules. They are similar to what Jackendoff (1983) terms conceptual structure and, thus, permit transfer across languages.

If graphic representations of knowledge structures are common across languages, they are a useful tool both for eliciting ESL students' background knowledge learned in their L1 and for accessing students' prior cognitive skills, e.g., classifying and describing, acquired in any language. However, whether or not graphic representations of knowledge structures can successfully elicit prior knowledge depends on (1) students' exposure to and interaction with graphics and (2) students' academic graphic literacy, i.e., whether the students can read and

write graphics presented in Chinese and whether they can understand graphic forms presented in another language.

Graphics in Classroom Tasks

Question 3. Did HK students encounter and interact with graphic in classroom tasks?

Findings showed that the HK students I observed interacted with a variety of graphic forms in the classroom (see Figure 4). They were mostly representational pictures (Levie & Lentz, 1982) which appeared singly or in a sequence. There were picture stories which the students had to read and understand. There were series of pictures showing procedures, e.g., how pyramids were constructed. Nonrepresentational pictures (Levie & Lentz, 1982) included maps of different kinds, showing political divisions, physical features, economic classifications, routes, locations and demographics. Graphic organizers were found in social studies and history books. They also appeared on the chalkboard as advance or post organizers in the form of trees or time lines. In mathematics and geography classes, the students had to draw, interpret, and answer questions on graphic representations of quantitative data, such as bar graphs, line graphs, pie graphs, pictographs and other charts. In addition, they had the chance once every two weeks to interact with computer graphics which they created by programming.

Figure 4. Graphic Forms HK Students Encountered

CATEGORIZATION	REPRESENTATIONAL PICTURES	NON REPRESENTATIONAL PICTURES
GRAPHIC FORM	Photos Pictures Drawings Picture stories Pictorial procedures	Maps: political contour road Graphic organizers: trees time lines tables/charts Graphs & charts: bar graphs pie graphs line graphs pictographs histograms Diagrams: picture- word word Computer graphics

The graphics the students encountered in classroom instruction represented various knowledge structures. The students were also provided with opportunities to practise various skills. In some language classes, the linguistic and cohesive devices of knowledge structures were explictly taught. Examples of knowledge structures in instruction are shown in Figure 5.

Figure 5. Knowledge Structures Form-One Students Encountered in the Classroom

CLASSIFICATION	PRINCIPLES	EVALUATION/VALUES
Math: classifying statistical representation Geog: classifying problems HK people face Sci: defining solvents & solutes Lang: categorizing genres in written Chinese	Chi. Hist: explaining causes & effects of the Boxer Rebellion Hist: explaining causes of the decline of the Roman Empire Sci: drawing conclusions from solubility experiments Fashion Design: learning general and safety rules of the clothing workshop	Chi.Lit: discussing the right way to deal with people S.S.: discussing/rating advantages of living in cities Writing: writing on the advantages and disadvantages of watching television Ethics: debating whether form-one students should date
Sci: comparing solubility of solvents Math: comparing bar graphs and histograms Hist: comparing Confucianism with Taoism Fashion Design: labelling parts of a skirt	Sci: following laboratory experiment procedure Hist: drawing time line of events in Alexander the Great's life Religion: completing time line of events before Jesus' crucifixion Chi. Hist: telling stories of the Three Kingdoms Fashion Design: following steps of patterning procedure	Writing: writing on "Emigrating to a foreign country: My views" Math: doing project on preference of brand name sports wear; choice of extrcurricular activities
DESCRIPTION	SEQUENCE	CHOICE

Classification. In Mathematics, the teacher explained classification and grouping when she discussed different ways of representing statistics. In Geography, the students were asked to classify the problems HK people face. In Science, the students learned the definitions of solvents and solutes. The language teacher discussed different categories of writing, e.g., persuasive, narrative, and descriptive, and the characteristics of each.

Description. In Science, the students compared the solubility of solvents in different

temperature and form. In Mathematics, the teacher compared bar graphs with histograms. In History, the teacher compared the philosophy of different religious beliefs, e.g., Confucianism and Taoism. In Fashion Design, the students identified and labelled the parts of a skirt and the measurements.

Cause-effect. In Chinese History, the teacher explained the concept of cause-effect when she talked about the Boxer Rebellion. "Nothing comes from nothing," she explained, "Nothing happens without a cause. Everything in history is connected. There is always a cause followed by a result." The text passage she read was full of the language of cause-effect. In World History, likewise, the teacher asked questions about the causes of the decline of the Roman Empire, discussed the meaning of cause-effect, and talked about the causes and effects of political upheaval with the help of a diagram. In science classes, the students drew conclusions from experiments and made generalizations about solubility and its relationship with temperature. In Fashion Design, they studied the general rules and safety rules of the workshop.

Temporal Sequence. Sequences were found in laboratory experiment procedures in science classes, in time charts in history classes, and in story telling in History, Chinese History and Literature. The students were required to complete time charts, e.g., important events in Alexander the Great's life, the last few days of Jesus' life. In Fashion Design, they learned clothing production procedures, followed patterning procedures, and carried out sewing procedures. They encountered language of temporal sequence as well.

Evaluation. Values were discussed in Chinese literature classes, e.g., the right way to deal with people. In a social studies class, the students discussed the disadvantages of living

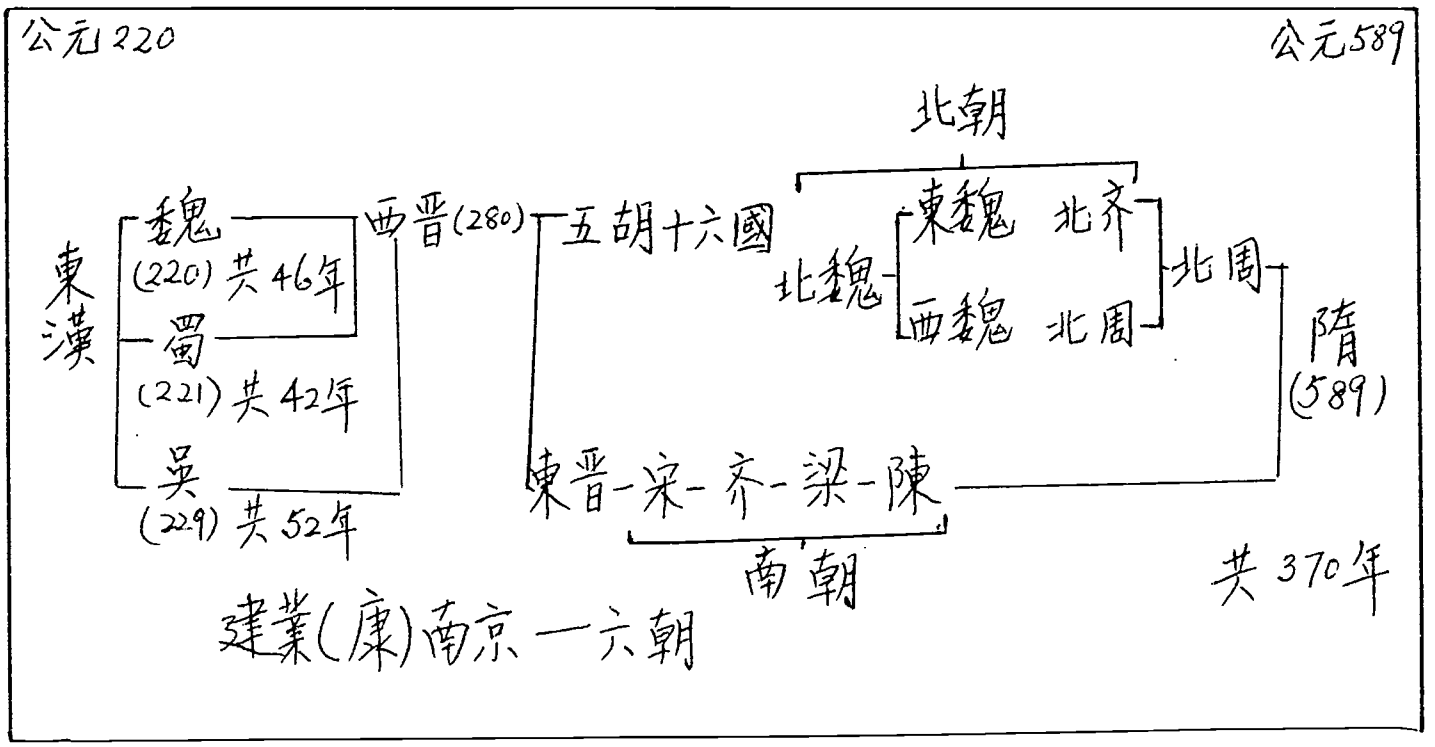
in cities in general, and in HK in particular. The teacher discussed the problems encountered by HK residents and the students were asked to suggest solutions to the problems. They wrote about solutions to the pollution problem and the advantages and disadvantages of watching television. They took part in debates, e.g., whether or not form-one students should start dating.

Choice and decision making. The Chinese literature teacher talked about values at different times and taught the students to make right choices. She also referred to the language of evaluation and choice. Explicit teaching of language of evaluation and choice was also effected in a writing class when the students had to write an essay on "Emigration to a foreign country: My views." In a group project, the topic of which was on preference, they had to (1) select a topic, e.g., preference of brand name, favourite extra-curricular activity, and best television actor/singer; (2) make a survey of fellow students' preferences; and (3) choose the right graphic to represent the data.

Moreover, the students engaged in various graphic-related tasks in the classroom. The teachers usually drew the students' attention to textbook illustrations, such as maps and charts and those which reinforced or explained the text. In a history class, the teacher referred to the colour symbols and arrows on a map, told the students what they represented, identified all the places, asked the students to study the map, and asked questions about it. Some of them built graphics on the chalkboard while presenting the lesson. In a Chinese history lesson, the teacher explained the function of the graphic which she had put on the board saying that it was to help them to understand and remember the information. She narrated the events of history and built a branching time line (see Figure

6) at the same time. She showed the meaning of the lines, the spaces, and the shape of the graphic and how different events led to the war of the three countries. Sometimes the students had to answer questions on graphics displayed on the chalkboard either in writing or orally. Some of the teachers prepared their own graphics on handouts and worksheets. A worksheet on Biblical Knowledge consisted of a pictorial time line and a time chart of events leading to Jesus' crucifixion with blanks for completion. The teachers usually went over the graphics with the students before requiring them to do exercises on them. Homework was set after every class. It consisted of answering questions in the textbook or accompanying workbooks which were as a rule well illustrated. In other words, HK students were required to study, write about, and reproduce graphics. Similar to the Vancouver students I observed, the HK students interacted with various forms of graphics because there was curricular need (Tang, 1991a).

Figure 6. Teacher-Constructed Graphic



In a quiz on the Roman Empire in World History, the teacher set two questions. One of them was to list the organization of the republican form of government in Rome. Of the 40 students present, 34 of them answered the question by drawing a tree graph. They were trying to recall a diagram of the republican form of government in Rome on page 137 of the textbook. The students had written explanatory notes on the diagram in the textbook. One of them had put three stars by it; others had put the words "Very important" near it. Because of the importance the teacher attached to the graphic, the students must have memorized the graphic while studying for the quiz.

I should reiterate that these are isolated examples which in no way reflect the whole picture. Moreover, the quantity of graphics the students encountered does not indicate that the teachers did not attach importance to the written word. Quite the contrary, teaching and learning were mostly text-based, hence the teachers' constant complaints about the students' low written language proficiency. Only in practical lessons in the prevocational school did the teachers and students rely on graphics more than on texts.

These examples of graphic representations of knowledge structures and graphic-related tasks which form-one students encountered in classroom instruction in HK represent some of the formal schemata which are available to the students. If the students are literate in academic graphics, it indicates that graphic representation of knowledge structures can be used to build and activate ESL students' prior knowledge. What remains to be discovered is whether or not HK students are literate in academic graphics. This question is addressed in the next section.

Students' Academic Graphic Literacy

Question 4. Did HK students know how to present knowledge in graphic form?

The students I observed experienced no difficulty representing knowledge graphically after they had been explicitly taught, a finding which confirms the results of an ethnographic study conducted in two grade-seven classrooms in Vancouver (Tang, 1991a). In a group project in which the students had to represent the findings of a survey in graphic form, all the six groups of students successfully completed the task. They chose a topic, carried out the survey, and represented the data in a bar graph, a pictograph, or a pie graph. An example is found in Figure 7. In their discussion, they were aware of the need to convert numbers to percentages in a pie graph. They were successful because all the steps had been explicitly taught and they had understood the technique of showing quantity or frequency by means of a graphic. When marking their projects, the teacher checked the topic, title, unit specification, e.g., number in thousands, total number, labels, legend and accuracy of representation, which she had emphasized in class. They understood how to choose a suitable graphic form to represent, organize and interpret (Levin, Anglin & Carney, 1987) information.

Figure 7. Student-Constructed Graphic

中一C班同學穿的鞋牌子名

牌子名	人數
NIKI	
BOSSINI	
ELLESSE	
REEBOK	
LA GEAR	
PUMA	
MOFORK	
K. SWISS	
KAMACHI	
YASAKI	

 = 一人

A group of students in the Chinese middle school showed their ability to transfer knowledge to different situations. Prompted by my questions, the students volunteered to do a survey to find out form-one students' preference of learning strategy. They started brainstorming which resulted in a recorded list of strategies. Then they drew a chart and started asking among themselves their favourite strategy. In the discussion period, they found out that favourite could mean the most 'fun' or the most 'effective' and decided that they would choose to find out the most 'effective' strategy. They formulated the question and started developing a frequency chart which they later translated into a bar graph having asked everybody in the class. Incidentally, 24 of the 40 students in the survey chose diagrams as the most effective strategy for presenting lessons (see Figure 8).

Figure 8. Students' Preference of Learning Strategy

中一C學生學習方法

方法	人數
講解	正
圖表	正 正 正 正 下
問答	
作業	
遊戲	丁
故事	正
筆記	下

Question 5. Could HK students interpret and construct meaning from graphics in instructional materials?

Interviews with individual students showed that secondary students understood textbook illustrations as well as other graphic representations of knowledge structures. I randomly chose a number of students from different schools. I went over with each of them textbooks, handouts, notebooks, and other instructional materials. I asked them to tell me what each textbook illustration was about. There were graphics representing each of the knowledge structures in the Knowledge Framework. The students could all show their understanding of different kinds of graphic forms including pictures which elicited a story; comparison charts comparing the author's intent and style of two chapters; classification charts and trees which categorized various objects and activities; diagrams with arrows showing cause-effect; maps which defined political divisions and described locations; cycles which showed principles, e.g., the water cycle; and signs and symbols, e.g., question marks which showed choice and decision making and checks and crosses which signified choice and evaluation. They were using the Chinese equivalent of the terms classification or organization, description and comparison, principles and cause-effect, sequence or procedure, evaluation or value, and choice or decision-making. According to most of the students, It was because the teachers drew their attention to all illustrations that they could answer all the questions about the illustrations.

Question 6. Could HK students understand graphic representations of knowledge structures presented in a second language?

I interviewed a number of students from School A and School C (see Figure 2). Those who had encountered certain graphic forms in their L1 could make out the meaning of similar graphics presented in a second language. I interviewed 13 students and required them to show their understanding of a number of graphics taken from English textbooks used in Canada. The graphics represented all the knowledge structures in the Knowledge Framework. They included both representational and nonrepresentational pictures (see Figure 9). The captions and labels were in English. It is interesting to note that with their limited English they could make out accurately what many of the graphics were about. In other words, a graphic in English could elicit their prior knowledge acquired in Chinese.

Figure 9. Graphics Used in the Interview

CLASSIFICATION	PRINCIPLES	EVALUATION
Classification tree Classification table Pie graph	Cause-effect cycle Cause-effect table	Evaluation chart
Map Picture Comparison table Line graph Bar graph	Time line Time chart Process chart	Pictures/ cartoon bubbles
DESCRIPTION	SEQUENCE	CHOICE

The students seemed to be familiar with classification trees, a graphic form common across languages (Tang, submitted for review), whatever the topic. A thirteen-year-old boy in a prevocational school answered,

> *It is a diagram for classifying or organizing. When one thing branches out and is divided into many things, it is classification. When many things are arranged to make one whole, it is organization. This diagram can be one or the other* (translated from Chinese).

All the form-one students I interviewed identified it as a classification diagram. They explained,

> *This thing branches into two, and these two branch again. That is dividing. That is sorting* (translated from Chinese).

They had no difficulty identifying maps. They recognized visual cues (Hurt, 1989) such as the compass points, the scale, and the legend. They could all explain the picture comparing early men. They had seen similar pictures in Chinese textbooks.

All the students could explain a cycle accurately when it was a picture-word diagram. When there were no pictures or symbols to help them, they looked at the shape and, with the help of prior knowledge, made an intelligent guess. The following are two interpretations of the same graphic, a cycle:

> *(1) It shows the life cycle of something, some insect, maybe. It goes from one stage to the next and then the next. Finally it goes back to the first stage and starts all over again.*
>
> *(2) It is a principles or theory diagram. It shows the causes leading to a result.*

> *You can start from any place. In the direction of the arrow, this causes the next event. The second event causes the next one and the next one. If we like tennis, we practise every day. If we practise every day, we become good players. If we are good players, we like the game* (translated from Chinese).

The students were aware of the knowledge structures principles and sequence and the graphics representing them. However, certain diagrams and tables are mainly words in cells. To interpret these graphics, a degree of language proficiency is required. Other representations of sequence, such as non-cyclical process charts, seemed to present less misinterpretation. They were aware of simple visual cues (Hurt, 1989) such as arrows which could show procedure or direction. They explained,

> *The arrows show it is a procedure. It means you do one part first. Then go to the next part. Then go to the third part. It must be a procedure* (translated from Chinese).

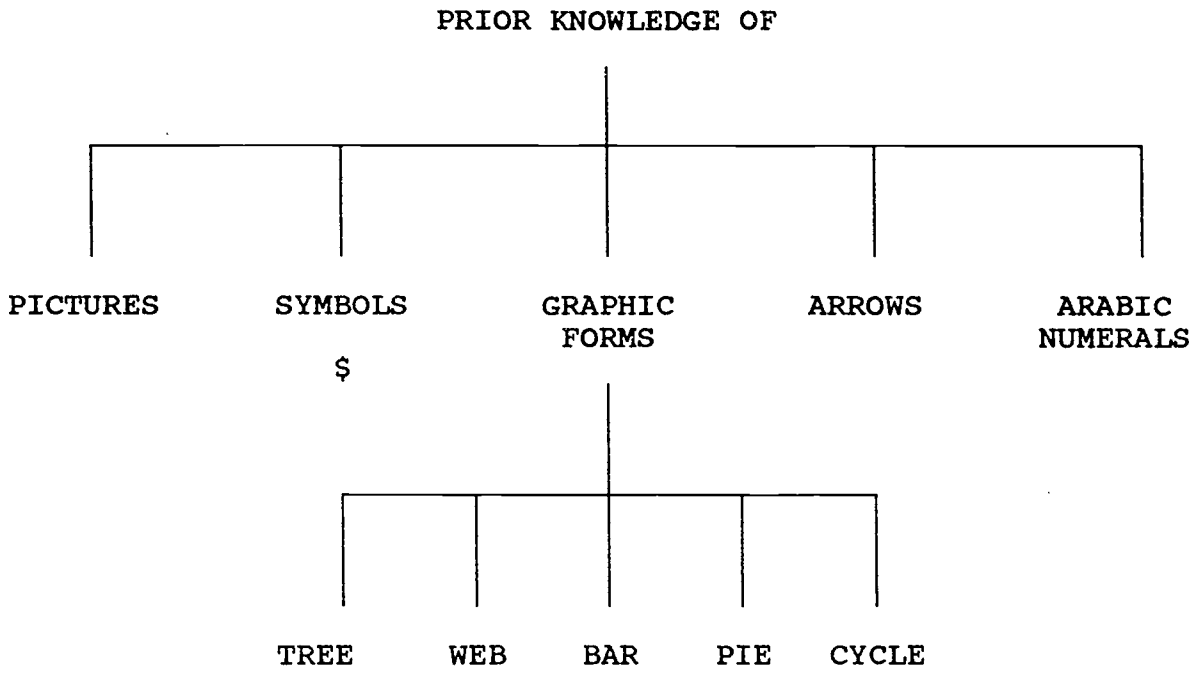
They recognized time lines by the dates and labels such as B.C. and A.D.

> *It shows the great events that happened in a period. It shows the event which happened on a certain day or year* (translated from Chinese).

The students only guessed that the evaluation table was a table "for comparing the value or price of something" from the +/- signs. They could not understand the words in the cells so they did not understand what it was about. However, words, such as "judgment", "evaluation", "value" and, "comparing" came up in their replies. The pictures displaying good and bad habits for students to make choices were easily understood. They were representational pictures and the checks and crosses were the visual cues they relied on.

In short, representational pictures and maps were easily identified. So were quantitative graphics. Bar graphs and line graphs, with the coordinate axis, the x axis and y axis, are common across cultures. So are pie graphs and pictographs with Arabic numeral labels and the "$" and "%" symbols. Most of the students were familiar with the different forms of graphics for displaying survey data. In the same way, they could identify time lines and time charts without hesitation. They recognized Arabic numerals as well as the abbreviations "B.C." and "A.D.", e.g., 220 B.C., which could be found in their Chinese history books (see Figure 10).

Figure 10. Graphic Forms and Conventions
Students Recognized



The students had come across many charts or tables, but when it was in an unfamiliar language, they could only make intelligent guesses. Thus, the same form elicited different responses, e.g., a comparison table, a preference table, a cause-effect table, and a classification table. The recognition of other graphics depended on the students' knowledge of certain vocabulary items. One of the charts had the words 'Very good', 'Good', and 'Poor' on the first row and the students decided that the chart was a judgment or evaluation chart. A student recognized the words 'city' and 'country' and guessed that it was a comparison chart.

Question 7. How did HK students construct meaning from graphic representations of knowledge structures?

The students relied on the form, the shape, the title, headings, and labels to construct meaning from graphics. At the interviews, some students started from the title; others started from the details. On the whole, however, they looked at the shape first and formed a judgment. Then they looked at the title to verify their first impression, and the headings or labels if the graphic was in Chinese. When they knew the language, they took advantage of it to interpret nonrepresentational graphics. Representational pictures were usually more easily interpreted.

A thirteen-year old girl expressed her construction of meaning from graphics as follows:

> *I have never come across these diagrams before. But I have seen similar ones in my own language. I recognize some words and symbols. I know some English. I put two and two together from my previous experience. I make some guesses. And*

I don't make many mistakes (translated from Chinese).

This supports the thesis that the available formal schemata built in students' L1 can be activated and graphic representations of knowledge structures are to a large extent the most efficient tools to effect the activation.

The research questions which this study set out to answer have been addressed. However, the classroom observations revealed some interesting findings which merit our attention. They are described in the following section.

Teaching/Learning Styles

Finding 1. The language of instruction affected student participation in the classroom

The language of instruction in most of the content classes was Chinese. The principals of the Anglo-Chinese schools were concerned about the students' low English proficiency which, according to them, were declining. While they were aware that the "mixed code" style of teaching had been criticized by educators as being a primary cause of a decline in English levels (Education Commission, 1990), they were more concerned about the urgency to prepare form-one students for English-medium instruction and learning. They encouraged content teachers to use as much English as possible in content classes. However, in both the Anglo-Chinese grammar school and the prevocational school, the content-area teachers, with two exceptions, taught in Cantonese. They usually translated some terms into English, and wrote the English version of specific vocabulary items on the chalkboard. They explicitly taught the meaning and pronunciation of the words. Some examples of the English terms taught are 'histogram,' 'the water cycle,' 'solvent,' 'solubility,' 'programming,' 'photocopier,' 'x axis,' etc. Whether or not the students retained these vocabulary items

depended on the frequency of occurrence of particular items. Most of the students recognized some of the words and their meanings, but they did not know how to pronounce them.

The effect of the language of instruction on student performance merits some attention. In spite of the principals' concern about the students' English proficiency and the advocacy for English as the language of instruction, the students in all the classes I observed participated more actively and appeared to perform more effectively in Chinese-medium classes. In one class, the teacher insisted that only English was allowed. She struggled to make herself understood by the students with little success and struggled even harder to elicit responses from the students. The result was a total lack of response on the part of the students. When called upon to answer a question, they just stood up and stared at the teacher. They appeared quiet, passive, and ignorant either because they could not understand English or because they could not express what they wanted to say in English. Often, after a short pause, the teacher provided the answer. This pattern continued until the end of the lesson. The only responses were mono-syllabic answers chanted out in chorus. I observed the same group of students in other situations in which teaching was done in Cantonese. A large number of students responded appropriately. The students were able to demonstrate their knowledge and skill when the lesson was conducted in Cantonese. Moreover, they showed themselves to be intelligent students who knew how to ask questions and initiate discussions.

The implications are obvious. In the first place, ESL students who do not respond to the English-speaking teacher are not learning disabled or retarded or emotionally disturbed;

they may not even be shy and passive by nature. They may be literate and articulate in their L1 and are disadvantaged by their inability to understand and speak English. Second, in order to maintain their academic and cognitive development, students have to be allowed to perform certain classroom tasks in their L1. May be teachers have to look upon code switching as a positive phenomenon. Third, we have to find ways to lower the linguistic demand for ESL students who have to learn content knowledge in a second language. Graphic representation of content knowledge may be one of the most effective solutions to the problem.

Finding 2. HK students encountered a variety of classroom tasks and teaching styles

Different teachers employed different teaching techniques and organized different classroom tasks. They usually delivered information by verbal explanation. Some of them read aloud or asked individual students to read aloud a paragraph in Chinese literature, history, and English language classes. Often, they summarized the chapter on the chalkboard, either in the form of a graphic or in the form of notes, while the students copied what was on the chalkboard into their notebooks. This occurred in Social Studies, History, Geography, and Chinese Literature. There was story telling. A few of the teachers attempted to prepare the students for English-medium instruction by translating some vocabulary items from Chinese to English. Occasionally, there was brainstorming followed by whole-class discussion. Hands-on experiences were provided in 'practical' and laboratory classes such as Computer Studies and Science.

The students were exposed to different techniques in varying quantities according to the subject area and the teaching style of the teacher. However, one technique stood out;

teacher-talk or explicit teaching played an important part in the secondary classroom and took up a large proportion of class time in the grammar schools and the 'theory' subject areas in the prevocational school. It was not always lecturing; the teachers usually presented the lesson orally including one or some of the following: teacher questioning, chalkboard writing, and reading aloud.

Teaching was very course-book oriented and instructional-material oriented. Both the teachers and the students needed written records of what the teacher had taught partly because of their concern for examinations. The teachers invariably referred to the textbook or instructional material at some point in the lesson. In some classes, e.g., History, the teacher instructed the students to underline phrases in the textbook. Underlining appeared to be a form of outline which most of the other teachers gave in the form of handouts or notes on the chalkboard. The students relied heavily on handouts and notes which were sometimes in chart form. Class work and homework assignments consisted of answering comprehension questions found at the end of a chapter or section in the textbook and completing workbook exercises or worksheets which consisted of exercises, such as question-answer, completion of blanks, construction of diagrams and charts, etc. Homework was mostly individual work with an occasional group project.

Another classroom task which was carried out in both language and content classes was discussion. Discussions between the students and the teacher were sometimes student-initiated when the students asked questions for clarification. More often, the students held discussions with their neighbours both for clarification and for verification. Very often, the teacher did not encourage such d' cussions which were considered inappropriate behaviour

or disruptions. However, it was in these discussions or negotiations that the students made out the teacher's intent regarding the task they had to perform or that they understood the teacher's explanation and instruction. Thus, we cannot overlook the importance of allowing students to negotiate, to work cooperatively, and to hold discussions in their L1. In general, students in HK and those in Vancouver experience much the same teaching techniques with variations in the frequency of occurrence. The greatest difference is in the language of instruction.

DISCUSSION

The above examples are but a sample of the data collected. However, they have contributed to some interesting findings (see Figure 11). In the first place, knowledge structures as defined by Mohan (1986) are reflected in the curricula and instruction of both HK and Canadian intermediate classes. They are present in academic Chinese discourse and English discourse. Knowledge structures are common across languages and, thus, their graphic representations can be used for activating prior knowledge learned in ESL students' L1.

HK students encounter many of the knowledge structures in graphic form in their learning. Many graphic forms are common across languages and so are textbook illustrations. Moreover, HK students enjoy a high level of graphic literacy; they are aware of different graphic representations; they interact with graphics; they are able to construct meaning from different graphic forms; and with their limited English proficiency, they can also understand graphic representations of knowledge structures presented in English. This

finding suggests that semiotic acts (Hodge & Kress, 1989) within the same culture, e.g., the culture of lower secondary textbook illustrations, may be performed successfully across languages. In other words, a large quantity of graphic forms and conventions are common across languages and cultures and are, thus, retrievable in a second language. It appears that graphic representations of knowledge structures systematically presented can be used for activating ESL students' prior knowledge learned in their L1. How can the above be effected? The following section gives suggestions for using the Knowledge Framework and graphics to enhance ESL student learning of language and content.

Figure 11. Findings of the Study

CATEGORY	FINDINGS
GRAPHICS IN INSTRUCTIONAL MATERIALS	1. Knowledge structures are found in content-area textbooks used in HK 2. Graphic forms and conventions are similar in HK and Canadian textbooks and instructional materials
GRAPHICS IN CLASSROOM TASKS	3. HK students encountered and interacted with a variety of graphic representing different knowledge structures
ACADEMIC GRAPHIC LITERACY OF HK STUDENTS	4. HK students could cooperatively present knowledge in graphic form 5. HK students could interpret and construct meaning from graphics in instructional materials 6. HK students could interpret graphics presented in English 7. HK students constructed meaning from graphics by looking at the title, the shape, graphic devices, such as arrows and labels (if understood) of the graphic
TEACHING/ LEARNING STYLES	The language of instruction affected student participation in the classroom: there was a total lack of student response in English-medium classes Code switching was a common phenomenon in the classroom Teaching was course book oriented and instructional material oriented. Students relied heavily on instructional materials. Students relied on student-student discussion (carried out with or without the teacher's blessing), to understand the teacher's explanations and instructions.

CONCLUSION	Graphic representations of knowledge structures are to a large extent common across English and Chinese. HK students enjoy a high level of graphic literacy. Graphics can be an effective tool for bridging prior knowledge learned in L1 and new knowledge to be learned in English.

IMPLICATIONS FOR ESL AND CONTENT TEACHERS

The Knowledge Framework can be used in content classrooms to enhance ESL student learning of English and content simultaneously. It has been adopted with considerable success in ESL classrooms in Vancouver (Early, Mohan & Hooper, 1990; Tang, 1991b; Tang, 1992). Adopting the framework entails (1) explicit teaching of knowledge structures or text organization; (2) explicit teaching of graphic representation of knowledge structures; (3) explicit teaching of linguistic and cohesive devices of knowledge structures; and, (4) setting tasks for students to practise constructing graphics from expository prose and, constructing expository prose from a graphic. It takes advantage of the commonalities, i.e, knowledge structures, across languages to activate prior knowledge. It also highlights the differences, i.e., linguistic and discourse structures to effect the acquisition of a second language and the learning of content knowledge.

Explicit Teaching of Knowledge Structures

To implement the Framework, teachers have to plan their units and lessons according to the Framework. They have to be systematic and explicit when they draw students' attention to knowledge structures. They have to link the cognitive skill to the text, and to teach the students to identify the top-level structure of text passages.

Explicit Teaching of Graphics

Teachers can explain the meaning of the knowledge structure by means of graphics. There are graphic forms which are specific to each knowledge structure, e.g., the tree and web for classification, the table for comparison, and the time line for sequence. Teachers should be aware of these and make use of appropriate graphics to present knowledge in all

subjects. Graphics can provide a focus for reading. They can make visible the structure of the passage and highlight the top-level structure. If the same graphic forms are consistently used across subject areas, they can help in the transfer of knowledge across the curriculum. If they are used in both Chinese-medium and English-medium instruction, they can contribute to the transfer of knowledge across languages. Teachers should point out to the students the conventions of textbook illustrations, such as the title, the form, headings, and labels. They can go further by making use of graphics to present information and, perhaps, setting examination questions in graphic form as well.

Explicit Teaching of Linguistic and Cohesive Devices

Teachers should point out the linguistic signals of each knowledge structure to the students so as to help them to identify text which reflects that particular knowledge structure. In both English and Chinese, there are sets of linguistic devices specific to each knowledge structure. Explicit teaching of the linguistic devices of each knowledge structure is important because of the difference in text organization between Chinese and English. For example, the semantic relations of classification exist in both Chinese and English social studies texts, but when a Chinese classification text passage is translated into English, the difference in the sequential order of the text becomes obvious. While Kaplan's (1966) graphic representation of the rhetorical structure of languages is an overstatement (Kaplan, 1987), the differences in sequential order between English and Chinese are a reality. This is the area in which no formal schema is available for retrieval. Therefore, whatever the language, background knowledge of the linguistic and cohesive devices of that language has to be built, and when ESL students learn content knowledge in a second language, linguistic

and cohesive devices of the second language have to be learned anew. Knowledge structures and graphic representations of knowledge structures permit transfer from one language to another, but the new linguistic and cohesive devices have to be learned afresh and practised frequently by students.

Setting Student Tasks

An important step is to design tasks for students to practise identifying knowledge structures, linguistic devices, and graphics as well as constructing graphics from text passages and writing text passages from a graphic. This is the step which raises prior knowledge to the availability level where it is ready for activation. Teachers in HK did set tasks which required the students to represent knowledge and data in graphic form as well as tasks which required them to interpret graphics and represent them in spoken and written language. To implement the model, teachers should set the tasks regularly; make the link between the graphic and the knowledge structure; and make the connection between the knowledge structure and the linguistic and cohesive devices. They can provide opportunities for students to write a paragraph from a graphic. It is important to suggest linguistic devices and ensure that students know how to link sentences, and how to present information, e.g., a topic sentence, cohesive devices, concluding statement, etc. Constructing a paragraph from a graphic is a step towards writing expository prose and demonstrating their comprehension of content knowledge in English. Below are some guidelines for using graphic representation of knowledge structures to enhance ESL student learning of content both in the planning and conduct of the lesson:

GUIDELINES FOR USING GRAPHICS

In Lesson Preparation

1. Read the chapter to get the gist of the content and identify the knowledge structure. Prepare a structured overview, or graphic organizer, which best summarizes the content of the chapter (see Tang, Wilson & Matsoso, 1993). The graphic will help you to plan the content you are going to present.
2. Read one section of the chapter. Identify the knowledge structure. Pick out illustrations such as tables, diagrams or charts which may be used to depict this section.
3. If the illustrations in the chapter are inappropriate, read the section again and develop an appropriate graphic which best represents the section.

In the Classroom

1. Present the structured overview of the chapter, then present new information in small chunks.
2. In presenting a section of the chapter, display a blank or partially blank graphic on the overhead projector. Activate students' existing knowledge about the topic. Use the language of the particular knowledge structure, e.g., description, consistently. This can be a large group, small group or individual task. Even if the students have limited knowledge of the specific topic, they can be encouraged to draw on any related knowledge to make predictions.
3. Ask the students to cooperatively put the information they have provided in the appropriate blanks. Or, as an alternative, complete the graphic cooperatively with the

students.

4. Help the students to develop the habit of always referring to illustrations in instructional materials.
5. To prepare the students to read a section of text, guide them in making predictions about the text using a graphic. Ask them to check their predictions. Enable them to complete the graphic while they read the text.
6. Use a graphic to pre-teach vocabulary, both content vocabulary items and linguistic devices, e.g., language of cause-effect.
7. Show the students how to use graphic organizers to identify prior knowledge and to restructure prior knowledge.
8. Show the students how to use graphic organizers as a learning strategy for understanding, remembering, and expressing content. Show them how to graph text.
9. Teach the students to interpret graphics from various perspectives. Teach them to transform graphic representation into text either orally or in writing. Draw their attention to linguistic devices.
10. Give the students practice in writing a coherent passage from a graphic.
11. Set assignments, examinations, and tests which require the students to fill out tables or graphics.

If both language and content teachers realize the power of the Framework and if they base their curriculum and lesson planning on the model and approach the teaching of language and content through the model, they will be able to bring about the building and activating of prior knowledge to enhance ESL student learning of language and content.

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