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Author(s)	Kwan, TYL; Chan, SY
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CHILDREN'S PREFERENTIAL MODES OF SPATIAL COMMUNICATION

Kwan, Tammy [1]
Chan, Eva [2]
The University of Hong Kong, tylkwan@hkucc.hku.hk[1]
HKCCCU LOGOS Academy (Hong Kong), chanesy@netvigator.com[2]

Abstract: *A group of lower primary children (age from 8-9 years old) was given a task to present spatial information to communicate with their peers about wayfinding to their school from the nearby mass transit railway station. The children were left with their own preferential choice to decide what mode of spatial communication was used to do the task. Different frameworks of cartographic analysis were used to understand the mapping quality of such spatial communication if children opted to draw map to show the spatial information. Selected children from distinctive categories were interviewed to further illuminate their spatial consideration when drawing the map to complete the task. The outcome of this study is hoped to provide insight to teachers the venue to understand their children better in terms of their giftedness in spatial and visual ability. Such understanding enables teachers to better prepare for meaningful and effective teaching in spatial related topics and issues.*

INTRODUCTION

Research in early childhood education (Elkind, 1988) suggests that children learn either by play-oriented tasks according to their own free activity or preference based on their personal experience; or they learn through instructions where tasks are practiced repeatedly and mechanically to enable their final remembrance of the content and/or mastery of the skills.

The play-oriented approach works on the belief that when children's inner life or personal experience is transformed into action through learning by doing, they will develop their understanding (Pramling, 1996). The children "create their own knowledge from their activities according to their level of maturity" (1996:566) which are often dependent on "content and context" (1996:567) to reveal inductive learning. In view of that, Clay (1991) and later Pramling (1996) argue that teachers are encouraged to go into the content and context of learning and to find out from particular children's reaction and expressions on assigned task and activity.

On the other hand, the instructional approach assumes learning occurs only after the children have acquired all the relevant foundational facts and knowledge. Then through frequent repetition of drills and practices, understanding will eventually take place. This approach is similar to the deductive concept attainment model as advocated by Joyce (Joyce et al, 2004). There is also the assumption based on Piaget (1929) that learning of children is developed according to chronological and hierarchical stages. However, there is also the counter argument that children's understanding or ability to perform certain tasks and activities is related to their personal experiences which can take place at very young age (Liben and Downs, 1989). Kwan (1995) summarized the different view points and labeled them as the Piagetian and Non-Piagetian schools of thought on children's intellectual development related to how children acquire spatial knowledge.

Balchin and Coleman (1965) strengthened the modes of communication by adding 'graphicay' to the existing 'literacy', 'oracy' and 'numeracy' to form a complete pack of ace in the card. According to the Piagetian school of thought, children of the age 8 to 9 years old operate in the concrete stage and they seem like using verbal transference (Pramling, 1987) to show they are able to perform the task through a process of active construction and hence are able to learn to understand something in a social and cultural context (Vygotsky, 1987; Wenger, 2002). However, when it comes to address the spatial information, it will be of both educational and research interest to find out the preferred mode of communication chosen by the children to handle the task given to review their learning capability to demonstrate abstract spatial understanding has taken place.

THE STUDY

This study inclines to adopt the 'play-oriented task' approach to find out how well the children know about their familiar school environment. Children were given the task to communicate to their friends how to get to the school from the near-

est MTR station. The prime purpose of this study is to investigate the children's own choice to decide on the mode of communication they prefer to use to convey this piece of spatial information to reveal their inductive understanding and experience of their familiar school environment. For those children who chose to use graphical communication such as pictorial drawing or map sketch to communicate with their friends, their mapping ability will subject to further investigation.

Twenty lower primary children, at the age of 8 to 9 years old, decided at their own choice to choose their preferred mode of communication to perform the task in September 2004 when the school academic year began. The instruction given by the teacher was a simple question "How do you inform your friend to get from the MTR station to the school?" Immediately the children raised many questions such as "Should I write about it?" "Am I supposed to draw it out?" "Can I just tell my friend how to get to the school?" or "Can I ask him to go into centa-map (a popular map web site to locate places in Hong Kong) and find out the way to the school?" etc. However, the teacher did not provide any further hint except just to repeat the question and stress it was up to the children to decide how to perform this task. The children were asked to do this at home and turned in the 'product' next day when they came back to school. It was understood that when children were asked to do the task at home, they might turn to their parents to ask for help. They might also refer to other source materials that were available at home to do the task. This includes map books, map website or other relevant leaflets that shows information of the school district. Hence, the children were asked to indicate at a later stage the extent that they did the task by themselves or with parental assistance. If the latter, how did the parent help. The outcome showed that all kids did the task by themselves but they might have talked to their parents on how to go about doing it.

The twenty children were asked to do the task again two months later in November to triangulate the consistency of their choice of a preferred mode of communication. However, to avoid completion of the task purely based on memorization and repetition, this time the children were asked to communicate their idea to their good friend to get back to the MTR station from their school, i.e. the reverse of the two target points. Besides, this time, they were asked to do the task in the class during the class teacher period of 40 minutes. The classroom does not provide computer internet access. There is also no provision of any map book or MTR leaflet for the children to make reference to. In other words, the children were actually left with the choice of the textual / word mode and the graphical mode of communication to use. With the latter, it will be mainly pictorial drawing or some kind of map / sketch drawing. This gives the argument that when children are not left with other sophisticated choices that they can choose from (like when they did the task at home), how would they choose to use their 'basic' mode of communication to convey the message to their friends, i.e. the word communication or the graphic communication.

The outcomes of the two tasks by the 20 children were tabulated, compared and analysed using Matthews (1984), McGeorge (1976) and Wilson (1980) framework of free-recall sketch drawing to show mapping ability (see Appendix 1). As a result, the children were categorized into six groups (see Appendix 2) of different preferential use of mode of spatial communication. A child from each group was interviewed briefly to capture their motive of using words or drawing diagram/map to perform the instructional task. The locational approaches of using maps by Kwan (1996) were used to discuss the outcomes of the children's view of choosing to draw pictorial diagram and/or map as the chosen mode of communication.

FRAMEWORK OF CARTOGRAPHIC ANALYSIS

Once the children were identified of their preferred mode of communication to convey the spatial information, several frameworks of cartographic analysis were used to understand the children's ability to draw free-recall hand sketches, their mapping ability and their approaches of displacing spatial information.

Analysing free reacall hand cognitive maps (McGeorge 1976)

McGeorge devised a framework to look at how children drew diagram to include significant landmarks or features and how they were arranged to form appropriate cluster relation to each other. He proposed three levels of grading or analyzing the free-recall hand drawing of the children.

Level 1: Undifferentiated Egocentric
Such sketch maps are concrete, egocentric and undifferentiated. Elements in the map are unorganized, or organized topologically in terms of the child's egocentric viewpoint or experience of the environment. No differentiation of other possible points of view.

Level 2: Differentiated & Partially Co-ordinated into Fixed Subgroups
Such sketch maps have one or more clusters or subgroups of elements corresponding to different cognized areas of the environment. These clusters are relatively independent and lack co-ordination between them, so that the relations between the elements within the cluster exhibit a higher level of organization than the relations between different clusters. Elements within cluster may be related geometrically, using Euclidean spatial relations, but between clusters relation will be only topological.

Level 3: Operationally Co-ordinated & Hierarchically Integrated
Such sketch maps are organized on a co-ordinated and abstracted reference system to which different elements and clusters of the environment are related and to which they are subordinated. The organization extends across most of the map. Elements are related both projectively and geometrically, with angles, shapes, size and relative distance all taken into account.

Mapping Ability to reflect spatial concept development in map drawing and understanding (Matthews, 1984)

Level	Mapping ability	Code	Grading Performance
1	Pictorial	P1	Grade 1 of pictorial and pictorial verbal responses
2	Pictorial-Verbal	PV2	
3	Pictorial-Plan	PP3	Grade 2 of hybrid maps of pictorial plan and pictorial plan verbal variants
4	Pictorial-Plan-Verbal	PPV4	
5	Plan	P5	Grade 3 of plan and plan verbal maps
6	Plan-Verbal	PV6	

This three-grade system of classification by Matthews is seen to represent stages in the developing understanding of mapping as an activity and mode of representation. Grade 3 maps require a range of cognitive ability, including rotation, scaling, generalization and representation, all or some of which will be missing from Grade 1 and Grade 2 maps. Hence, Matthews' framework is regarded as a useful complement to McGeorge's framework for classifying free recall hand sketch of cognitive maps.

Mapping Ability to show Four Map Elements (Wilson 1980)

Wilson (1980) adapted a scale originally developed by Synder, Feldman and La Rossa (1975) to produce a quick and easy-to-use methods of scoring four important map elements, namely: arrangement (A), proportion (P), plan view (V) and map language (L). Such mapping ability is calculated as the total score of the four elements which are broken down into 6 levels of mapping ability performance with zero representing non-ability and six representing the highest level of ability performance..

Locational approaches of using maps (Kwan, 1996)

Children have different ways to handle and decode map information. Similarly, they will have different preference in choosing what information to include or to encode in the pictorial or map drawing. This also takes into the account of how they choose to assemble a particular piece of information. The approaches of using maps (Kwan 1996) are borrowed to examine how children draw the pictorial diagram or the map where they often 'mind-walk' the route to compare and match the recalled significant locational knowledge of landmarks and features that they encountered. The locational approaches are: rote memorized pattern of operation; structured sequential pattern of operation; and concurrent pattern of operation.

FINDINGS AND INNITIAL DISCUSSION

Children's preferred mode of communication (see Appendix 1 for full display of outcomes)

September first task : among the twenty children involved in doing this take home task, some chose to use word/text mode only, some chose to use both word/text mode and also graphical mode which includes both pictorial drawing and map drawing. Some children also chose to download relevant map from web site on the internet and then draw on the walking route which is still considered as a form of graphical presentation. Some also chose to pick up leaflet from the MTR station to show the walking route in the nearby area.

November second task: The twenty children who involved in doing the September task were asked to do the task again but have the two target points put in reverse order. Since the children were asked to do the task in class and there was no facility to enable them to get assess to internet, all children except one opted to use the graphical means to communicate the idea. The result is summarized in the next table:

Mode of Communication Chosen	First Task (%)	Second Task (%)
Words	32.5	22.5
Graphics (Pictorial drawing)	10.0	10.0
Graphics (Map drawing)	45.0	67.5
IT (download from internet or CD-ROM)	10.0	0.0
Ready made source (leaflet and brochure)	2.5	0.0

It is clear that the majority children opted for graphical communication in both instances. Among those who used words in fact used both words and drawings to communicate the spatial information to their friends. However, there was just one child who chose to use words and text in both tasks to give wayfinding instruction to his friend. Among the eight children who were invited to talk briefly (in Cantonese) to the teacher to explain their choice between words and drawings, the followings are some reasons given to explain why they chose to write in words or to draw a picture or map to be their preferred mode of communication.

Child A: *I thought it was easier to do the task (by using textual information). When drawing a map, it doesn't have to be right. I think if I write it, then it is easier to do so.*

The translated verbatim of Child A implies that meanings conveyed by words are concrete and definite. There is no confusion to understand the textual meaning. On the other hand, there is no definite way to draw a map to show the information and hence it is easier for him to make mistake and therefore is considered more difficult to do so.

Child D: *Map is easy to understand. But words need further explanation.*
Child E : *It is easier to draw map. You can immediately imagine how to walk the route. It is simple and easy to tell a clear message. Words can be too lengthy and detail. They are bored to read. When I decided which method to show the walking route, I will think if it is easy to be understood by other people and also I don't want to bore people.*
Child M: *There are the logos of the school and the MTR on the map. Also map is more accurate. It won't give the wrong information. There are not too many words cluster together. Also it is easier to read the words on the map. Besides, there is the grid reference. If you have a compass, you can tell the direction as well.*
Child Q: *Map can tell people about different places. If I have to write that out, I am not able to write clearly. People do not understand what I write, because they may think in a different way.*
Child T: *Words are unclear and not concrete to use as reference. But you can 'see' the place from a map.*

The translated verbatim above show the opposite view to Child A. For children who chose to use graphical mode to communicate the idea, they considered map a useful medium to show the walking route because map is clear. Not like words which can be clumsy and lengthy, map is able to tell a lot of information through signs and symbols (e.g. the logos of school and MTR), important word labels (e.g. place and street names), location (e.g. grid reference), and direction (e.g. through compass bearing). There is the implication by the children that such information presented on map is clear, precise and direct as they contain a specific meaning whereas writing in words can be subjective and people reading the words may have a different way to understand the words (e.g. words are not concrete and people may think in a different way).

Grouping of Children's Mapping Ability (See Appendix 2 for full information)

Apart form just one child who chose to use words and text to perform the two tasks, the other nineteen children have all used the graphical means to perform either the first or the second or both tasks. These children were grouped into five categories. Their graphical presentations were analyzed using Matthews (1984), McGeorge (1976), and Wilson (1980) frameworks to reveal their mapping ability. The five categories are:

1. Use words/ textual mode in the first task and then graphical mode the second task. (3 Children)
2. Use graphical mode in both tasks and the mapping ability is more or less the same in both tasks. (5 children)
3. Use graphical mode in both tasks and the mapping ability of the first task is significantly better. (6 children)
4. Use graphical mode in both tasks and the mapping ability of the second task is somewhat better. (2 children)
5. Use information technology (IT) mode in the first task and mainly graphic mode in the second task. (3 children)

Some general findings are noted from the outcome of such groupings. They are:

- Children of category one showed low level of mapping ability. Despite they all drew pictorial-plan map (PV6 according to Matthews), the level of drawing and map elements inclusion (according to McGeorge and Wilson) were low. This implies that the children did not have a strong preferred mode of communication used. When they chose graphic mode, the ability of map drawing was low.
- Children of category two used graphic mode to communicate the two tasks. But the mapping ability shown in the two tasks was more or less the same. This indicates that there was no major difference to their drawing outcome if the task was completed at home or in class. However, children of this category drew with a greater degree of variation according to Matthews because one can find drawing ranging form pictorial (P1) to plan-verbal (PV6) showing the six different levels of drawing. But using Moore and Wilson, then it is easy to note the level of map drawing and inclusion of map elements was low.
- Children of category three showed a clear preference towards the graphic mode of communication. The distinctive outcome was that they drew a much better quality map in their first task with the possibility of spending longer time to do the task, seeking parental help to suggest idea, tracing outline from existing map to help with their final product. This can be reflected from the consistent drawing of plan-verbal map (PV6) and of higher level of drawing showing reasonable hierarchical co-ordination and integration (Levels 2 to 3 according to McGeorge) and with more sophisticated map elements shown in the drawing (total map score of 16 to 19 out of 20 according to Wilson). But when the children were asked to do the task in class when they were confined by time and resource availability, the mapping ability showed a dramatic drop which to some extent actually represented their true mapping ability. Nevertheless, children from this category show their genuine interest and perhaps their giftedness in using graphical mode to enhance communication.
- Children of category four showed the reverse of category three. They drew map of better quality in their second task when compared to their drawing done at home. However, the quality improvement of the second drawing did not show a big dramatic difference when compared to children of category three.
- Children of category five showed their intuitive preference to use IT to help with their drawing to convey the message when they were asked to do the task at home. They were able to access to the most easily available source to help with their communication task. It is also very natural to do so in this modern time when IT is getting so popular. However, when conditions in the classroom were not supportive to use IT, they reverted to the obvious preferred mode of graphic communication. Surprising enough, children from this category drew maps of the same level (if not higher) of mapping ability when compared to children of category three. In other words, it appears that children from this category were gifted in the spatial mapping ability and hence drew higher quality map to communicate the idea to other people.

Asking the children to do the task again in class but in the reverse order allows us to see the consistent preferred mode of communication chosen by the children and their true mapping ability to draw the map when conditions to perform the task were kept the same to all children. The outcome shows that children still, to a large extent, naturally prefer to use the graphical mode to communicate spatial information and their ability to do so varies according to children. This is very much related to the inborn spatial ability of the children and their personal exposure to spatial experience when they have more chances to travel with parents and have common practice to get access to IT source to locate and handle information. It also appears that children will draw better map if they are familiar with map base materials that they obtain from internet or from CD-ROM.

Though it is immature to comment on any drawing approach to encode spatial information, the interview data indicated a 'rote memorized pattern of operation' according to Kwan's (1996) locational approach of using maps. One can see that children were familiar to their school environment and they quoted a lot of familiar landmarks such as traffic light, zebra crossing, shopping malls to enrich the information of the walking route. Several children actually used the verb 'see the route' on the map which indicated their process of 'mind-walking' to recall familiar memorized features and landmarks.

Child A: *Well, (in my second attempt), I just felt like to draw a map (because) It tells the way and allow you* ***to see*** *other places.*
Child E: *You can immediately imagine* ***how to walk*** *the route.*
Child R: *Seems that map can show a lot clearer to other people. It contains a lot of information. You can also* ***see the walking route****.*

Further study into this aspect will further enhance teachers' understanding of the children's spatial ability and preferred mode of communicating spatial information. This will facilitate teachers to design challenging tasks to further develop the children's spatial ability. The collaborative teaching between IT and map training may further advance the children's learning in this regard. The conventional instructional approach does not appear to be at all challenging and motivating to stimulate children to use lived experience to construct and encode spatial knowledge to show their understanding in the spatial sense.

Appendix 1: Outcome Modes of Communication Preferred by the Children and Their Associated Scoring to show Mapping Ability

Child Code	Prefer mode of communication		Matthews(1984)		McGeorge (1976)		Wilson (1980)									
							1st task					2nd task				
	1st task	2nd task	1st task	2nd task	1st task	2nd task	A	P	V	L	total score	A	P	V	L	total score
A	W	W & M	/	PV6	/	1						1	1	1	0	**3**
B	W & M	W & M	PV6	PV6	1	1	1	1	1	1	**4**	2	1	4	1	**8**
C	W & L	M	/	PV6	/	1						1	1	1	1	**4**
D	W & M	W & M	PV6	PV6	3	2	4	3	5	4	**16**	3	2	3.5	2	**10**
E	D & M	M	PV2 (with keys)	PPV4 (with keys)	1	2	0	0	0	3	**3**	3	2	3	3	**11**
F	W & DM (IT)	W & M	/	PV6	/	2						5	3	5	3	**16**
G	M	M	PV6	P5/PV6	3	2	5	4	5	3	**17**	3	2	3	1	**9**
H	D	D	PV2	P1/PV2	1	1	0	0	0	0	**0**	0	0	0	0	**0**
I	CD (IT)	M	Interactive, multimedia	PV6	/	2						2	2	3	2	**9**
J	W	W	/	/	/	/										
K	W & DM (IT)	M	/	PV6	/	3						3	3	5	5	**16**
L	M	D & M	PV6	PPV4	1	1	2	2	3	5	**12**	2	2	3	3	**10**
M	M & D	M	P1	PV6	/	0- 1	0	0	0	0	**0**	0	0	0	0	**0**
N	M & W	M & W	PV6	PV6	1	1	1	1	1	1	**4**	1	1	1	2	**5**
O	W	M	/	PV6	/	1						1	2	1	2	**6**
P	M	M	PV6	PV6	3	2	4	3	5	4	**16**	2	2	3	2	**9**
Q	M (trace copy)	D & M	PV6	PPV4	3	2	5	4	5	5	**19**	2	2	3	2	**9**
R	M & W	M & W	PV6	PV2	2	1	2	2	3	2	**9**	0	0	0	2	**2**
S	M	M & W	PV6	PV6	3	1	5	4	5	4	**18**	1	1	1	2	**5**
T	M	M	PPV4	PV6	1	2	1	1	3	2	**7**	1.5	2	3.5	2	**9**
	W:3+7X0.5/20=32.5% D:1+2X0.5/20=10% M:6+6X0.5/20=45% DM:2X0.5/20=5% CD:1/20=5% L:1X0.5/20=2.5%	W:1+7X0.5/20=22.5% D:1+2x0.5/20=10% M:9+9X0.5/20=67.5% DM:=0% CD;=0% L=0%														

where
1st task = task completed in September
2nd task = task completed in November

W= word / text (11/40=27.5%)
D= pictorial drawing (4/40=10%)
M= self drawn map (22.5/40=56.25%)
DM= download map (1/40=2.5%)
CD= CD ROM (1/40=2.5%)
L= leaflet information (0.5/40=1.25%)

where
P1=pictorial
PV2=pictorial-verbal
PP3=pictorial-plan
PPV4=pictorial-plan-verbal
P5=plan
PV6=plan-verbal

where
1=undifferentiated egocentric
2=differentiated & partially co-ordinated into fixed subgroups
3=operationally co-ordinated & hierarchically integrated.

Where
A= arrangement (0-5)
P= proportion (0-5)
V= plan view (0-5)
L= map language (0-5)
0 means not able to show the mapping ability of that particular element.
6 means the highest ability.
Total score from 0-20

Appendix 2: Grouping of the Children According to Their Preferred Mode of Communication.

Child Code	Prefer mode of communication		Matthews(1984)		McGeorge (1976)		Wilson (1980)									
							1st task					2nd task				
a	1st task	2nd task	1st task	2nd task	1st task	2nd task	A	P	V	L	total score	A	P	V	L	total score
Use words/ textual information in both tasks																
J	W	W	/	/	/	/										
Use words/textual information in the first task and then map in the second																
A	W	W/M	/	PV6	/	1						1	1	1	0	**3**
C	W & L	M	/	PV6	/	1						1	1	1	1	**4**
O	W	M	/	PV6	/	1						1	2	1	2	**6**
Use maps in both tasks and the cartographic quality is more or less the same																
H	D	D	PV2	P1/PV2	1	1	0	0	0	0	**0**	0	0	0	0	**0**
L	M	D/M	PV6	PPV4	1	1	2	2	3	5	**12**	2	2	3	3	**10**
M	M & D	M	P1	PV6	/	0-1	0	0	0	0	**0**	0	0	0	0	**0**
N	M & W	M/W	PV6	PV6	1	1	1	1	1	1	**4**	1	1	1	2	**5**
T	M	M	PPV4	PV6	1	2	1	1	3	2	**7**	1.5	2	3.5	2	**9**
Use maps in both tasks and the first drawn map was better than the second drawn map																
D	W & M	W/M	PV6	PV6	3	2	4	3	5	4	**16**	3	2	3.5	2	**10**
G	M	M	PV6	P5/PV6	3	2	5	4	5	3	**17**	3	2	3	1	**9**
P	M	M	PV6	PV6	3	2	4	3	5	4	**16**	2	2	3	2	**9**
Q	M (trace copy)	D/M	PV6	PPV4	3	2	5	4	5	5	**19**	2	2	3	2	**9**
R	M/W	M/W	PV6	PV2	2	1	2	2	3	2	**9**	0	0	0	2	**2**
S	M	M/W	PV6	PV6	3	1	5	4	5	4	**18**	1	1	1	2	**5**
Use maps in both tasks but the second drawn map was better than the first drawn map																
B	W & M	W/M	PV6	PV6	1	1	1	1	1	1	**4**	2	1	4	1	**8**
E	D & M	M	PV2 (with keys)	PPV4 (with keys)	1	2	0	0	0	3	**3**	3	2	3	3	**11**
Use IT to help with the completion of first task and the second task was done by map																
F	W & DM (IT)	W/M	/	PV6	/	2						5	3	5	3	**16**
I	CD (IT)	M	Interactive, multimedia	PV6	/	2						2	2	3	2	**9**
K	W & DM (IT)	M	/	PV6	/	3						3	3	5	5	**16**

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