

Project No.: 2007/0020

## Part C Project Detail

### *Background:*

A child has to have the basic handwriting skills in order to master the schoolwork. This is particularly important for the primary education when handwriting forms an essential component of daily school tasks. An Interactive Computerized Handwriting Training Program (ICHTP) was funded by the Quality Education Fund in 2005 and developed aiming at enhancing children's Chinese handwriting. The program was targeted to improve the basic skills in preparation of handwriting, namely, the visual perceptual (VP) skills, visual-motor integration (VMI) skills and force modulation through interactive computer activities. The participants, who were first grade students, showed significant improvement in both their handwriting speed and the basic writing skills including the VP and VMI. Positive feedbacks were also obtained from their teachers and parents on the intervention program.

However, most teachers reported that it remained difficult to identify children with handwriting difficulties in an objective manner, due to the lack of a standardized handwriting assessment tool and local references to assess Chinese handwriting. The test batteries practiced in western countries would not be valid to measure the Chinese handwriting since Chinese words are characterized by the logographic and complexity based on strokes formation. Different teachers also have various criteria on "good handwriting". It is therefore essential to develop a standardized assessment tool with local references to assess both the quantity (speed, pen pressure, in-air time) and quality (correct stroke sequence, stroke pattern, sizes, etc) of Chinese handwriting such that earlier identification of children with problems in writing could be made.

This study aims to develop and standardize a handwriting test battery for assessment of handwriting performance in terms of both process and products (Cheung, & Li, 2007). A Chinese handwriting assessment tool (CHAT) based on pattern recognition techniques would be developed to evaluate the student's handwriting performance. The CHAT will evaluate the legibility in terms of sharpness, tidiness, stroke sequence, missing strokes, extra strokes, handwriting speed, in-air time and ground time and pen pressure exerted during writing. Identification of different components of handwriting may assist a teacher, a psychologist or a therapist to plan the intervention program accordingly.

A normative study across the primary school children (6-12 years old) will be conducted. If children are identified to have specific handwriting deficits (phase I of the study), more in-depth evaluation of the sub-types of writing problems could be done, namely, (1) phonological/morphological awareness, (2) visual-perceptual processing skills, and (3) motor-sensory coordination (Lai, Lam, & Chow, 2001).

In phase II of the study, three types of intervention program will be developed to address on these three sub-types of children with specific handwriting problems. Previous studies have been carried out in facilitating Chinese handwriting education with information technologies (Kim et al, 1997; Ozaki et al, 1995; Chou and Yu, 1993; Kato, 1992; Leung and Komura, 2004). Our training program will be developed based on the IT platform with feedback mechanisms such that children can practice the training at school and at home.

For improving phonological and morphological awareness, it is believed that through mental

rehearsal and practice, the skills of handwriting could be strengthened and later on, generalized to more complex words and sentences. For training of ocular motor and visual-perceptual skills, our project team will develop a computerized learning system similar to ICHTP so as to facilitate their ocular motor skills, VP and VMI skills. To train the sensor-motor functions, special adaptive gripping system will be installed to the computer as the key switch board to facilitate training of the fine motor and grip modulation skills through different computer games. Finally, all subjects will be placed in the handwriting training group using the VACHE (Virtual Assistant for Chinese Handwriting Education) training program which is a pattern recognition web-based education system to provide feedback to children while writing Chinese characters (Tang et al, 2006; Tsang and Leung, 2002; Tzeng et al, 1996; Chwee 2002; Teo et al, 2002). Children can view the teacher's handwriting examples and practice writing the characters via the system. The system can automatically perform checking and indicate handwriting errors precisely. Potential handwriting errors including stroke sequence, extra stroke, missing stroke, broken strokes or concatenated stroke can be found such that students can realize their problems at once. The CHAT will then be implemented to the children to compare the results of their scores before and after the intervention program.

In phase III of the study, the comprehensive assessment and intervention program would be evaluated using standardized outcome measures. Results will be presented at a professional seminar and at the parents' seminar. Training workshops will then be provided to educate both the teachers and parents on the training strategies using the computerized training software that was developed. It is with the vision that all children will benefit from this comprehensive project and improve their Chinese handwriting.

### Goals and Objectives

#### Goals:

1. To develop an objective Chinese handwriting assessment tool (CHAT) for assessing handwriting performance and to collect the normative data of local Chinese children aged between 6-10 years;
2. To screen and assess the handwriting performance and performance components of children with handwriting difficulties using the CHAT system;
3. To identify specific deficits of children in the areas of phonological and morphological function, visual motor function, visual perceptual function and sensory-motor function, using standardised assessments such as MTVP-R, VMI (5<sup>th</sup> ed);
4. To evaluate the effectiveness of the comprehensive handwriting training program (which includes basic training of performance skills and also practices of handwriting using the pattern recognition technology in helping children to improve handwriting performance);
5. To transfer the training program to teachers and parents if proven to be effective.

#### Objectives:

By the end of the project, we should be able:

- i) To gather the normative data of Chinese handwriting performance (CHAT) from children studying between Primary One to Primary six levels (approx 900 children);

- ii) To assess the specific problems among those children identified to have handwriting problems using standardized assessment batteries, namely, MVPT-R, VMI;
- iii) To implement a comprehensive training program based on mental rehearsal and assistive device on 120 students referred by teachers and/or assessment scored below 2 standard deviations from the mean scores of CHAT and other specific skill tests;
- iv) To deliver workshops to teachers and parents on enhancement of the Chinese handwriting performance that includes experience sharing among teachers and parents, skills transfer, and most importantly, re-motivating these children back to the academic world.

#### Needs Assessment and Applicants' Capability

Prof Cecilia Li is the Professor of Department of Rehabilitation Science at The Hong Kong Polytechnic University. She has enriched experiences in running large scale service and research projects in the area of people with special needs. She has successfully obtained grants from the Social Welfare Department of Hong Kong, on two projects, which are "Information Technology Training for people with mental handicap" and "Pre-Vocational Information and Communication Technology Training for People with Autistic Spectrum Disorder". She is experienced in both clinical and teaching dimensions of pediatric intervention strategies including handwriting. Her PhD. study was a local study on children's hand function including assessment of functional skills such as writing and chopsticks manipulation. She has published several research papers and presented at international conferences in the area of pediatric hand function. In addition, she has been doing consultancy work for children with fine motor and handwriting dysfunction in the Rehabilitation Clinic, The Hong Kong Polytechnic University.

Prof. Chetwyn Chan is the Head of Department of Rehabilitation Sciences at The Hong Kong Polytechnic University. He specializes in cognitive neuroscience and its application to rehabilitation and human-task interface. Currently, he focuses on two main areas of research: mental imagery and neuroplasticity for enhancing functional regain, and mental ergonomics. He is the founder of Applied Cognitive Neuroscience Laboratory in the department. He has published widely in international journals on cognitive neuroscience and rehabilitation psychology. One of his recent publications is on the topic of "How do figure-like orthographs modulate visual processing of Chinese words?" (Chan et al, *Neuroreport*, 2007), which attempted to explain how subtle differences in Chinese words can influence its perception as reflected from the activations at the frontal and occipital areas. His other work on the neural processes underlying mental rehearsal (e.g. Chow, Chan et al, *Neuroreport*, 2007) can also help design a step-by-step mental rehearsal program for children with handwriting difficulties to use self-regulation strategy in writing of the Chinese words.

Prof. Chan Shui Duen is the Head of Department of Chinese & Bilingual Studies at The Hong Kong Polytechnic University. She specializes in Chinese Language Teaching, Language Testing, Lexicology and Sociolinguistic. She was project leader for the Development Project on Recommended list of Chinese Characters and Recommended List of Chinese Lexical Items for Students' Learning at Primary Levels (commissioned by Curriculum Development Institute of Education and Manpower Bureau, HKSAR, 2005-2007). One of her recent publications is on the topics of "Character and Word List for Hong Kong Primary Education (香港小學學習字詞表)" (Chan & Chinese Education Section of Curriculum Development Institute, 2007), which can help

to identify complexity and utility of the word list of primary students.

Dr. Howard Leung is an Assistant Professor of Department of Computer Science, City University of Hong Kong. His research interest falls into pattern recognition discipline. One of his projects, titled "VACHE", focuses on applying pattern recognition techniques to facilitate handwriting education and developing intelligent tools for Chinese Handwriting Education. The developed tools can evaluate students' handwriting and provide immediate feedback to the students thus the leaning efficiency can be enhanced. He has published several research papers on this topic which demonstrated the proposed algorithm used in the intelligent tool outperforms existing solutions.

Ms Wong Lai Ching, the principal of T.W.S. St. Bonaventure Catholic Primary School is very keen to help students in handwriting function as well as the curriculum learning. She has been showing concern to the children with handwriting problems and is very supportive in exploring different ways to assist her students in learning and her colleagues in dealing with the students with hand writing problems. Her collaborations indeed have contributed a lot to administering our previous programs. The schools can provide an actual teaching and learning environment with which the students are more familiar. Through the application of the training program to the local students with handwriting difficulties referred by the schools, we can have a more focused and local understanding on the difficulties of this group of students, and on how much the previously developed ICHTP can help.

### **Targets and Expected Number of Beneficiaries**

#### **Direct beneficiaries:**

1. A handwriting performance norm of P.1 to P.6 students will be created for an index Child Assessment Center, Education Department and other related primary education organizations as a reference when evaluating primary students' handwriting performance;
2. Target students in collaborating school(s) who will receive standardized assessment on handwriting performance (CHAT);
3. Collaborating school(s) where student assessment reports will be delivered;
4. Teachers and parents with children having handwriting difficulties.
  - Workshops will be provided and experience sharing encouraged among teachers and parents. This will allow them to acquire skills and information to help children with handwriting difficulties in daily life. Workshops to parents will be focused on introducing common handwriting problems and thus earlier notification of these problems among children.

#### **Indirect beneficiaries:**

1. Primary school students with and without handwriting difficulties

- The teaching strategies specially designed for children with special needs are also applicable to all students for improving their learning effectiveness generally (Education and Manpower Bureau, Hong Kong, 2004). Thus, with proven effectiveness, the Handwriting Tracer can be applied to all pre-school and primary school students for assessing their handwriting performance.

## 2. Clinical and educational professionals

- The assessment tool can provide a standardized assessment on children's handwriting performance. With the computerized assessment tools, the human bias on handwriting legibility can be waived. The objective and quantitative assessment results can provide a "common language" – a common norm in judging and assessing children's performance among clinical and educational professionals. It is also easier to explain the children's handwriting performance to other professions using a standard tool.

## 3. Teachers and caregivers who are interested in knowing more about children with handwriting difficulties and their management

- The CHAT provides a common language to both teachers and parents on students' handwriting problems. The workshops on helping strategies can facilitate parents' involvement in the studying process for the children. Cooperation and communication among teachers, parents and the children can be established and facilitated.

### Justification of the selection of specific target group

To achieve the learning goals set in the curriculum of primary education, students need to acquire good handwriting skills as learning and homework involve a lot of writing exercises. Students in primary 1 promoted from kindergarten school experience a great change in teaching and learning environment, structure and format. When students are promoted to more senior forms, they are often referred as having poor integration especially in areas of handwriting according to the increased handwriting requirements. Early intervention to children with handwriting problems is preferred. Those children with difficulties in reading, sensory processing and emotional and self-control will be excluded.

### Expected number of beneficiaries:

Beneficial Sector	Number of beneficiaries
P1 to P6 students	900 (for assessment and screening)
Children with poor handwriting	120
Teachers	200
Parents or Caregivers	200

### Implementation Plan with Time-line

Duration:

24 months (August 2008 – July 2010)

*Phase I: Development of the Chinese handwriting Assessment Tool (CHAT) and normative study on Chinese children's handwriting abilities*

## A. Development of the CHAT system

The CHAT will be developed in order to analyze the process and product of the students' handwriting with factors including handwriting speed, pen in-air time, ground time, pen pressure and legibility measures based on pattern recognition techniques. It will be designed and implemented by Dr. Howard Leung from City University of Hong Kong, and Dr. Cecilia Li from The Hong Kong Polytechnic University, according to the requirements given by occupational therapists from The Hong Kong Polytechnic University. The validity and reliability of the assessment tool will be tested prior to implementation. The main factors to be assessed include:

1. Overall perception of handwriting
  - i. Speed
  - ii. Alignment, spacing
  - iii. Handwriting script
  - iv. Pressure
  - v. Pen in air time and writing time
2. Appearance of the character
  - i. Size
  - ii. Rotation angle
3. Analyze the components of the character
  - i. Ratio between components
  - ii. Position of components
  - iii. Shearing angle

## B. Normative study on HK Chinese children

In our pilot study, we collected 73 cases with handwriting difficulties from P.1 to P.3 level ( $n_1=51$ ,  $n_2=9$  and  $n_3=13$ ) and measured their handwriting performance like speed, pen pressure and in air time. From the pilot sample, the minimum effect size is taken as 0.2277. To detect statistical difference in handwriting performance among three primary levels by one-way ANOVA method through PASS (Hintze, 2004), a minimum total number of 567 subjects is required to achieve 99.00% power with 5% type I error assumed. To prevent 10% attrition rate, the total number of subjects is increased up to around 630. If we project to P1 to P6 level, then the sample size will be around 900. To reduce the random variations due to school effect, we plan to take into account the number of schools in our study. To pursue the representativeness for the whole population, we decide to select more than one school (say two) per island, i.e. Kowloon, Hong Kong Island and New Territories, although the number of subjects will be enough if we select one school per island. Based on our previous experience, we could only recruit around 210 students from primary one to three students in one school. The sampling procedure will consist of two phases, i.e. stratified sampling followed by clustered sampling. The first phase is to stratify the schools by three different islands, i.e. Kowloon, Hong Kong Island and New Territories. Within each of these three strata, a random cluster sample of schools will be drawn within each stratum

(island). The second phase is to ensure that we will sample each P.1 to P.6 student from each cluster (school) that we have drawn within each stratum. By this combined way of sampling, the precision can be increased by stratified sampling and the cost reduction can be achieved by increasing sampling efficiency through cluster sampling. Therefore, providing handwriting assessment for 900 students is targeted in this project.

With schools selected, students will be contacted to join the project. Schedules will be set up after liaison with the principal and teachers of the schools to conduct handwriting performance assessment by CHAT using handwriting tracer. All participants will be assessed under similar environmental conditions in a quiet room of their school settings.

***Phase II: Implementation of the individualized training program for children with identified handwriting difficulties.***

**A. Identification of children with handwriting problems**

After the collection of the normative data, those children with assessment scores below 2 standard deviations from the mean scores of CHAT will be selected to join the phase II of the study. They will then be referred to occupational therapists and psychologists for specific tests to identify whether they have particular problems in phonological, ocular motor, visual motor or visual perceptual, sensori-motor functions. Some of the test batteries are listed below:

- a) Kids Imagining Ability Questionnaire (Kwekkeboom, Maddox & West, 2000)
- b) Mental Rotation Task (Williams et al, 2006; Wilson et al, 2004)
- c) Developmental Test of Visual-Motor Integration (VMI)
- d) Motor Free Visual Perceptual Test -Revised (MVPT-R)
- e) MULE system to measure the grip endurance
- f) Development Eye movement test (DEM)

These assessments offer health care and education professions a comprehensive view of a child's abilities. Thus, suitable intervention could be made accordingly.

**B. Training of performance components**

Based on the tests results, children are then categorized into three training programs as below:

**1. Mental rehearsal training of self-regulation strategy in writing**

Our previous research has demonstrated that task-specific mental rehearsal training improved the performance on functional tasks among a group of patients suffering from stroke (Liu, Chan et al, 2004a). In the mental rehearsal training, individuals were asked to break down the components of a task (such as folding garment), anticipate self-performance on task, develop strategy for modified performance, and mental practice modified performance (Liu, Chan et al, 2002). The results suggested that the three-steps of the approach, i.e. chunking, self-regulation and mental rehearsal, were each contributed to enhancing on performance (Liu, Chan et al, 2004b). Our research group further revealed that mental rehearsal in fact involved sequential mental processes: attend to stimulus, access to long term memory for images, generation of images, transformation of images, and maintenance of images (Chow, Chan et al, 2007). All of these provide a good

foundation for the development of a mental rehearsal program which targets to enable children with handwriting difficulties to adopt the self-regulation strategy for generating the image of the Chinese word and mentally rehearsing the word in the working memory before writing the word. Students joining the program will be taught the three-step strategy at the beginning of the program. They will then be exposed to a list of simple to complicated words and get familiarized with the writing of these words. They will practice the strategy with the learnt words. Once they can master the skills, they will work on the words which they have had difficulties in writing in classes. Their improvements in writing will be assessed using the instruments developed in other parts of this study.

### 2. Training of ocular motor and visual motor skills

The Interactive Computerized Handwriting Training Program (ICHTP) will be implemented to improve children's visual perceptual skills and eye-hand coordination skills. The software is comprised of computerized games which require a child to focus on either the visual perceptual functions by selecting the right answers from a group of photographic presentations or training the visual motor skills using a WACOM pen writer. Previous studies have indicated the positive effect of this training program.

### 3. Training of sensori-motor and grip modulation skills

An adapted gripper will be installed to each computer to train the fine pinch grip and power grip of the hand so as to prepare a child in prolonged gripping of the pen while writing. This gripper system was implemented in the ICHTP in our previous study. This new system will further incorporate both the fine precision grip such as tripod pinch, lateral pinch and the power grip function in preparation of handwriting.

### C. Training of handwriting skills using VACHE (Virtual Assistant for Chinese Handwriting Education)

Upon completion of the above three training program, all children will then be scheduled to join in the final training program using the Virtual Assistant for Chinese Handwriting Education (VACHE) system. The system will demonstrate the correct stroke sequences of a word and students are requested to copy the word with correct stroke sequence. The VACHE training will serve as the final step of training in the occupational performance, on top of the training of performance components. There will be a formal weekly one-hour training session conducted by experienced occupational therapists. The total training period is 4 weeks incorporating home exercises program. Students will be evaluated before, after and at one month following up the review on their handwriting skills, the visual motor co-ordination and visual perception using the standardized instruments.

### *Phase III: Transfer of the training program to teachers and parents*

#### A. Workshops for parents and teachers

At least two workshops, one for teachers and one for parents will be delivered along with the training program in each joining school. All workshops will provide information on identifying common handwriting problems among children with handwriting difficulties and suggest some



strategies to remediate their problems. The ICHTP and VACHE will also be introduced to the participants with demonstrations. Participated teachers and parents would know how the ICHTP can help to improve some of the children with poor handwriting due to poor visual motor integration, visual perceptual problems or other problems e.g. kinesthetic control. Teachers can be equipped to use the ICHTP for training and monitoring handwriting performance of children in the workshops.

A professional seminar will be conducted after the completion of the training program to share the project outcomes with professionals, teachers and parents. A progress report will be prepared every half year, a mid-way report will be submitted by the end of 12<sup>th</sup> month and a final report will be submitted after the project is completed.

Detailed Implementation Plan with Time-line

Aug 08				Jan 09								Jan 09					
Ax tool *																	
Subject Recruitment																	
				Assessment													
				Treatment Implementation													
				Workshop								Workshop					
												Data Analysis					

Timeframe	Objectives to be achieved	Expected Outcome
1 <sup>st</sup> – 3 <sup>rd</sup> month (3 months)	<ul style="list-style-type: none"> <li>◆ Design &amp; develop assessment tool and package manual</li> <li>◆ Modify existing VACHE system to suit students' need</li> </ul>	<ol style="list-style-type: none"> <li>1) Modified System</li> <li>2) Fully functional Handwriting Tracer</li> <li>3) Training manual</li> </ol>
1 <sup>st</sup> – 12 <sup>th</sup> month (12 months)	<ul style="list-style-type: none"> <li>◆ Recruit participants in different schools</li> </ul>	<ol style="list-style-type: none"> <li>1) Selection of suitable participants</li> </ol>
4 <sup>th</sup> -17 <sup>th</sup> month (14 months)	<ul style="list-style-type: none"> <li>◆ Conduct assessment in Primary schools for participant selection</li> </ul>	<ol style="list-style-type: none"> <li>1) Data collected for pre-treatment assessments</li> </ol>
7 <sup>th</sup> -20 <sup>th</sup> month (14 months)	<ul style="list-style-type: none"> <li>◆ Implement training program for children</li> <li>◆ Obtain feedback from teachers &amp; parents on administration of the ICHTP</li> </ul>	<ol style="list-style-type: none"> <li>1) Delivery of combine training</li> </ol>
12 <sup>th</sup> – 14 <sup>th</sup> month; 22 <sup>nd</sup> – 24 <sup>th</sup> month (6 months)	<ul style="list-style-type: none"> <li>◆ Seminars launched for parents and teachers</li> </ul>	<ol style="list-style-type: none"> <li>1) A seminar launched for sharing with involved teachers and parents, presenting the project outcome and effectiveness</li> </ol>
18 <sup>th</sup> –24 <sup>th</sup> month (7 months)	<ul style="list-style-type: none"> <li>◆ Organize and analyse assessment results</li> <li>◆ Round-up the project</li> </ul>	<ol style="list-style-type: none"> <li>1) Program evaluation report on training effectiveness</li> <li>2) Research paper on program evaluation</li> </ol>

	effectiveness ◆ Present the project outcome and effectiveness	
--	--	--

### Expected Deliverables and outcomes

#### *A. Intangible outcomes:*

1. Health care and educational professions can have a common parameter and tool in evaluating students' handwriting performance;
2. A better understanding of the underlying problems encountered by children with handwriting difficulties in terms of both handwriting process and the product;
3. Enhancement of awareness to handwriting problems among students in primary schools.

#### *B. Tangible outcomes:*

1. A norm on primary students' handwriting performance will be created;
2. A newly developed CHAT system which can be used to assess the students' handwriting problems in an objective, quantified way.

### Budget:

#### Budget Breakdown:

<i>Item</i>	<i>Duties and Justifications</i>	<i>Amount</i>
<b>A. Staffing</b>		
3 full- time Occupational Therapist II for 24 months	- liaise with the schools and other related organizations or departments - organize, plan and conduct the assessment schedule - monitor the project - implement training with weekly tuition - present on project findings	\$ 15,200 x 1.05 x 24 x 3 = \$ 1,149,120
1 part-time project associate for 24 months	- reach out for participants, prepare the assessment materials - assist in assessments for P1 and P2 students - work on data entry and analysis	\$ 7,600 x 1.05 x 24 = \$ 191,520
2 full time Research Assistant (specialized in computer technology) for 24 months	- specialized in computer technology to develop the objective screening tool for legible handwriting	\$12,000 x 1.05 x 24 x 2 = \$604,800
1 part time Occupational Therapist II for 24 months	- assist full time OT in assessment conduction and treatment implementation - assist full time OT in conducting	\$ 7,600 x 1.05 x 24 x 2 = \$383,040

workshops		
<i>Subtotal</i>		\$2,328,480
		<i>Rounded up to \$2,328,500</i>
<hr/>		
<b>B. Equipment</b>		
5 tablet PCs	- To support the digitized assessment tool and the data collection process	\$ 75,000
5 WACOM digitized systems	- To support the digitized assessment tool and the data collection process	\$20,000
Programming hardware and software	- For production of the online system in VACHE	\$10,000
<i>Subtotal</i>		<i>\$105,000</i>
<hr/>		
<b>C. General Expenses</b>		
Transportation Cost	▪ For staff to carry out assessments and deliver workshops in schools	\$ 10,000
Stationery, & photocopies	▪ Pens, papers, photocopies, printing charges for posters and promotion pamphlets	\$ 3,000
Preparation of training program in CD	▪ Materials and design of the software program	\$ 10,000
Printing cost	▪ For making program manuals ▪ For making workshops materials	\$ 3,000
Miscellaneous items	▪ Reinforcement for students and others ▪ Snacks and drinks for workshops and seminar ▪ Promotion and preparation of seminar (posters, pamphlets, rental fees for lecture halls)	\$ 4,000
Conference Fee	▪ Presentation and promotion of outcomes in local and international conferences, exhibitions, or fairs	\$10,000
		\$5,000
<i>Subtotal</i>		<i>\$ 45,000</i>
<b>Total</b>		<b>\$ 2,478,500</b>

**Evaluation Parameters and Methods:**

The progress of the proposed project will be evaluated in the following aspects:

**1. Production on the interactive training software program**

By the end of 4<sup>th</sup> month of the project, the Handwriting Tracer should have been developed with following functions: 1) Record writing time (on ground and in-air time); 2) Calculate the writing speed; 3) Record and trace back the writing pattern of each stroke, and 4) Record the handwriting pen pressure. This tool will be evaluated by panel including an experienced Occupational Therapist and an experienced Education professional.

#### 2. Workshops for teachers and parents

By the end of 14<sup>th</sup> month of the project, at least one workshop on introducing and teaching the use of the handwriting tracer and some strategies to assist children's handwriting performance in daily life should have been provided.

The workshops will be emphasized on the common handwriting problems and importance of early identification of handwriting problems in school or at home. Moreover, common coping strategies for children with handwriting problems will be introduced so that teachers can detect children's handwriting problems and adopt corresponding allowance/coping strategies.

#### 3. Number of primary one students participating in the project

By the end of 18<sup>th</sup> month of the project, a total of 450 students referred as having handwriting difficulties should have been assessed using the Handwriting Tracer as well as performance components assessment by MVPT-R and VMI. Ratings from parents and teachers on the same handwriting product should have been collected for these students. Baseline of handwriting performance should have been generated and major handwriting difficulties identified.

#### 4. Norm creation

By the end of 18<sup>th</sup> month, 500 primary school students' data would be collected and data would be generated for primary students (P.1 - 3) handwriting performance norm creation.

#### 4. Presentation of findings

By the end of 18<sup>th</sup> month, a public seminar will have been arranged for professionals such as teachers, and/or educational professionals working for children, and parents.

#### Sustainability of the outcomes of the project

The present project could benefit the education and health care sector through early identification of children with handwriting problems. With use of the digital-based evaluation tool, handwriting performance can be assessed and analyzed with quantitative and objective data. Children with specific handwriting problems could then be referred for early intervention or remedial action thus they could keep pace with the academic performance as they progress to different levels of studies. Correct identification of underlying problems leading to handwriting difficulties would also enhance the intervention strategies.

#### Dissemination/ Promotion

## 1. Presentations on the program progress and outcome

- Program progress will be presented to schools involved in the program continuously
- Project outcome will be presented to interested schools and parents

## 2. Publications of research output on

- 'Effectiveness of a combined training program of neuron-imaging, ICHTP and VACHE on children with handwriting difficulties'

**References:**

1. American Psychiatric Association (1994). Diagnostic and statistical manual of mental disorders (4<sup>th</sup> Ed.) Washington, DC: Psychiatric Association.
2. Audit Commission (1999). Chapter 7: Services for students with special educational needs. Report No. 33, October 1999. Hong Kong SAR: The Government Printer.
3. Baum, C. M. & Law, M (1997) Occupational Therapy Practice: Focusing on Occupational Performance. *The American Journal of Occupational Therapy*. 51 (4), 277-287.
4. Becker, H. (1986). Instructional uses of school computers (Issue No. 3). Baltimore: John Hopkins University, Center for Social Organization of Schools.
5. Board of Education Sub-committee on Catering for Students' Diverse Learning Needs (2002). Second Interim Report of the Board of Education Sub-committee on Catering for Students' Diverse Learning Needs. The Government of the Hong Kong SAR
6. Chan C. C. H., Leung, A. W. S., Luo, Y. J., & Lee, T. M. C. (2007). How do figure-like orthographs modulate visual processing of Chinese words. *Neuroreport*, 18(8), 757-761.
7. Chou, S.L., & Yu, S.S., (1993). Sorting Qualities of Handwritten Chinese Characters for Setting up a Research Database, In Proc. Intl. Conf. on Document Analysis and Recognition, 474-477.
8. Chow, K. W. S., Chan, C. C. H., Huang, Y-X, Liu, K. P. Y., Li, L. S. W., & Lee, T. M. C. (2007). Temporal course of vibrotactile imagery. *NeuroReport*, 18(10), 999-1003.
9. Chun-Hung Tzeng, Leon Hsu, Chien-Ping Chen and C.Uema, "A multimedia project in teaching Chinese and Japanese at Ball State University", IEEE Intl. Conf. on Multi Media Engineering Education, pp.445-452, July 1996.
10. Chwee Keng Tan, "An algorithm for online strokes verification of Chinese characters using discrete features", 8<sup>th</sup> Intl. Workshop on Frontiers un Handwriting Recognition, pp.339-344, 2002.
11. C.L. Teo, E. Burdet, H.P. Lim, "A robotic teacher of Chinese handwriting", HAPTICS 20002, pp.335-341, 2002.
12. Cubelli, R & Lupi, G (1999) Afferent Dysgraphia and the Role of Vision in Handwriting. *Visual Cognition*. 6(2), 113-128.
13. Education and Manpower Bureau (2004). Special Education. Information Sheet. The Government of the Hong Kong SAR, Oct 2004.
14. Education and Manpower Bureau (2004a). EMB-Figures and Statistics. Retrieved August , 2004 from The Government of the Hong Kong SAR, The Education and Manpower Bureau Web site: <http://www.emb.gov.hk/index.aspx?langno=1&nodeid=1038>  
<http://www.emb.gov.hk/index.aspx?langno=1&nodeid=1040>
15. Education Department (2000). Understanding and Help Students with Special Educational Needs: A Guide to Teaching. The Government of the Hong Kong SAR
16. Education Department (2001). Understanding and Help Students with Special Educational Needs: A Guide to Teaching. The Government of the Hong Kong SAR
17. Education Department (2002). Understanding and Help Students with Special Educational Needs: A

- Guide to Teaching. The Government of the Hong Kong SAR
18. Fearing, V. G., Law, M & Clark, J. (1997) An Occupational Performance Process Model: Fostering Client and Therapist Alliances. *Canadian Journal of Occupational Therapy*. 64(1), 7-15.
  19. Furner, B. (1985) Handwriting instruction for a high-tech society: Will handwriting be necessary? Report No. CS 208 970. Paper presented at the National Council of Teachers of English Annual Meeting, Houston, TX.
  20. Ho, C. S. H., Chan, D. W., Tsang, S. M., & Lee, S. H. (2000a). The Hong Kong Specific Learning Difficulties Behaviour Checklist (For Primary School Pupils) Manual. Hong Kong: Hong Kong Specific Learning Difficulties Research Team.
  21. Hong Kong Government. (1996). The Report of the Board of Education Sub-committee on Special Education. Hong Kong: Government Printer.
  22. Ka Ki Li, Howard Leung, Sutie Lam, and Cecilia Li, "An Assessment Tool for Judging the Overall Appearance of Chinese Handwriting based on Opinions from Occupational Therapists", Intl. Conf. on Web-based Learning (ICWL 2007), University of Edinburgh, United Kingdom, August 2007.
  23. Kai-Tai Tang, Ka Ki Li and Howard Leung, "A Web-based Chinese Handwriting Education System with Automatic Feedback and Analysis", Intl. Conf. on Web-based Learning (ICWL 2006), Penang, Malaysia, July 2006.
  24. Kato, T., (1992). Evaluation System for hand-written characters, In Proc. Machine Vision Applications in Character Recognition and Industrial Inspection, 73-82.
  25. Kerry Tsang and Howard Leung, "Teaching Stroke Order for Chinese Characters by minimal Feedback", Intl. Workshop on Frontiers in Handwriting recognition, pp.339-344, 2002
  26. Kim, D.H., Kim, E.-J., & Bang, S.Y., (1997). A Variation Measure for Handwritten Character Image Data Using Entropy Difference. *Pattern Recognition*, 30(1), 19-29.
  27. Kwekkeboom, KL, Maddox, MA, West, T. (2000). Measuring imaging ability in children. *J Pediatr Health Care*, 14(6), 297-303.
  28. Kwok, Y. L. S. (2000) Relationship Between Handwriting Performance and Perceptual Motor Skills on Children With and Without Very Low Birth Weight. Unpublished Master's Thesis. The Hong Kong Polytechnic University: Hong Kong SAR, China.
  29. Lally, M. (1981) Computer-assisted handwriting instruction for intellectual handicapped children and the role of visual and kinesthetic feedback processes. In W.H. Gladstones (Ed.), *Ergonomics and the disabled person* (pp.53-58). Canberra: Australian Government Printer.
  30. Lam, C. C. C. (2003). Developmental dyslexia. *Public Health and Epidemiology Bulletin*, 12(1).
  31. Leung, H., & Komura, T., (2004). Web-based Handwriting Education with Virtual Animated Teacher, International Conference on Web-based Learning (ICWL 2004), 293-300.
  32. Liu, K. P. Y., Chan, C. C. H., Lee, T. M. C., & Hui-Chan, C. W. Y. (2004a). Mental imagery for promoting relearning for people after stroke: A randomised clinical trial. *Archives of Physical Medicine and Rehabilitation*, 85, 1403-1408.
  33. Liu, K. P. Y., Chan, C. C. H., Lee, T. M. C., & Hui-Chan, C. W. Y. (2004b). Mental imagery for relearning of people after brain injury. *Brain Injury*, 8(11), 1163-1172.
  34. Liu, K.P.Y., Chan, C.C.H., Lee, T.M.C., Li, L.S.W. & Hui-Chan, C.W.Y. (2002). Case Reports on Self-regulatory learning and generalization for people with brain injury. *Brain Injury*, 16(9), 817-824. Longcamp, M. Anton, J. & Roth, M. et al (2003) Visual presentation of single letters activates a premotor area involved in writing. *NeuroImage*. 19, 1492-1500.
  35. Mancini, M. C. & Coster, W. J. (2004) Functional Predictors of School Participation by Children with disabilities. *Occupational Therapy International*, 11(1), 12-25.
  36. Olive, T. & Piolat, A. (2002). Suppressing visual feedback in written composition: Effects on processing demands and coordination of the writing processes. *International Journal of Psychology*, 37 (4), 209-218.
  37. Opper, S. (1996). Hong Kong's Young Children: their early development and learning. The Hong Kong University Book Press: Hong Kong
  38. Ozaki, M., Adachi Y., Ishii, N., & Koyazu, T., (1995). CAI System to Improve Hand Writing Skills

- by means of Fuzzy Theory, In Proc. IEEE Intl. Conf. on Fuzzy Systems and the Second Intl. Fuzzy Engineering Symposium, 491-496.
39. Preminger, F., Weiss, P. L. & Weintraub (2004). Predicting Occupational Performance: Handwriting Versus Keyboarding. *The American Journal of Occupational Therapy*, 58 (2), 193-201.
  40. Rice, A. H. (2000) Interdisciplinary Collaboration in Health Care: Education, Practice, and Research. *National Academic of Practice Forum*, 2(1), 59-73.
  41. Rigby, P. & Schweltnus, H. (1999) Occupational therapy decision making guidelines for problems in written productivity. *Physical & Occupational Therapy in Pediatrics*, 19(1), 5-27.
  42. Rosenblum, S., Parush, S. and Weiss, P. (2001). Temporal measures of poor and proficient handwriters. In Meulenbroek, R.G.J. and Steenbergen, B. (Eds.) *Proceedings of the Tenth biennial conference of the International Graphonomics Society*. (pp. 119-125). The Netherlands: University of Nijmegen.
  43. Rosenblum, S., Parush, S. and Weiss, P.L. (2003a) Computerized temporal handwriting characteristics of proficient and poor handwriters. *American Journal of Occupational Therapy*, 57, 129-138.
  44. Rosenblum, S., Weiss, P. L. & Parush, S. (2003). Product and process evaluation of handwriting difficulties. *Educational Psychology Review*, 15(1), 41-74.
  45. Schweltnus, H. & Lockhart, J. (2002) The Development of the Tool for Optimizing Written Productivity (TOW-P). *Physical & Occupational Therapy in Pediatrics*, 22 (3/4), 5-22.
  46. Sutton Hamilton, S. (2002). Evaluation of clumsiness in children. *American Family Physician*, 66(8), 1435-1440.
  47. The Chinese University of Hong Kong - Faculty of Education. (1998). Quality Education Fund Proposal: Designing a Battery of Assessment Instruments for Screening and Diagnostic Testing of Primary School Children with Specific Learning Difficulties in Hong Kong. Retrieved December, 2004 from The Government of the Hong Kong SAR, QEF Cyber Resource Center Web site: [http://qcrc.qef.org.hk/qef/project.phtml?proposal\\_id=1998/2298](http://qcrc.qef.org.hk/qef/project.phtml?proposal_id=1998/2298)
  48. Tsang, W. P. C. (1999) Hand Function Evaluation in Preschool Children with and without Physical Dysfunction. Unpublished Ph. D Thesis. The Chinese University of Hong Kong: Hong Kong SAR, China.
  49. Tseng, M. H & Chow, S. M. K. (2000). Perceptual-motor function of school-aged children with slow handwriting speed. *American Journal of Occupational Therapy*, 54, 1, 83-88.
  50. Smits-Engelsman, B.C.M. & Van Galen, G.P. (1997). Dysgraphia in children: Lasting psychomotor deficiency or transient developmental delay? *Journal of Experimental Child Psychology*, 67, 164-184.
  51. Williams, J, Thomas, PR, Maruff, P, Butson, M, Wilson, PH. (2006) Motor, visual and egocentric transformations in children with Developmental Coordination Disorder. *Child: Care, Health & Development*, 32(6), 633-647.
  52. Wilson, PH, Maruff, P, Butson, M, Williams, J, Lum, J, Thomas, PR. (2004). Internal representation of movement in children with developmental coordination disorder: a mental rotation task. *Developmental Medicine & Child Neurology*, 46(11), 754-759.
  53. 香港課程發展議會 (2004). 中國語文課程指引. 香港特別行政區：教育統籌局。
  54. 課程發現處 (2002). 中國語文教育學習領域課程指引 (小一至中三). 香港特別行政區：教育統籌局。