



Final Report of Project

Project No. : 2011/0162

Part A

Project Title: A computerized interactive training system for helping students with disabilities to acquire the skills in activities of daily living

Name of Organization/School: CHOI KUP SZE

Project Period: From 10/2012 (month/year) to 03/2014 (extended to 12/2014) (month/year)

Part B

*Please read the **Guidelines to Completion of Final Report of Quality Education Fund Projects** before completing this part of the report.*

Please use separate A4-size sheets to provide an overall report with regard to the following aspects:

1. Attainment of objectives
2. Project impact on learning effectiveness, professional development and school development
3. Cost-effectiveness – a self-evaluation against clear indicators and measures
4. Deliverables and modes of dissemination; responses to dissemination
5. Activity list
6. Difficulties encountered and solutions adopted

Name of Project Leader _____ Name of Grantee* _____

Signature: _____ Signature: _____

Date: 25 March 2015 Date: 25 March 2015

** Final Report of Project should be submitted via "Electronic Project Management System" (EPMS). Once submitted, these reports are regarded as already endorsed by the supervisor of the school/the head of the organization or the one who signed the Quality Education Fund Agreement for allocation of grant on behalf of the organization.*



Guidelines to Completion of Final Report of Quality Education Fund Projects

Please elaborate the following items in your evaluation of the project. It is expected that the guide would provide a reference to the project leader/team in reflecting on the effectiveness of the project.

1. Attainment of Objectives

The following items should be included in the evaluation of the attainment of each of the project objectives stated in the project proposal (*the information may be presented in a table form in the format of Table 1 in this Annex or in short paragraphs*):

Objective statement	Activities related to the objective	Extent of attainment of the objective	Evidence or indicators of having achieved the objective	Reasons for not being able to achieve the objective, if applicable
To design an innovative computer-assisted training method that is safe, economical, effective and versatile for disabled students to acquire different daily living skills.	<ol style="list-style-type: none"> 1. Meetings with occupational therapists were held to specify the training needs; 2. Specification of the hardware & software setting, and the features of the prototype. 	Fully achieved	<ol style="list-style-type: none"> 1. Specifications of the 3 training tasks defined. 2. A movable workstation with adjustable LCD arm mount designed for the prototype. 3. Handles as user interface for the training designed and fabricated. 	N.A.
To develop a prototype system based on the method for the training of specific activities of daily living (ADL), including food cutting, liquid pouring, and door opening.	<ol style="list-style-type: none"> 1. Development of the software for training the 3 ADL tasks. 2. Integration of the computer hardware and haptic user interface. 3. Design and installation of the movable workstation. 	Fully achieved	<ol style="list-style-type: none"> 1. A prototype system was successfully developed according the training needs and the design. 2. The results were reported and published in an international conference #. 	N.A.



To evaluate the usefulness and usability of the prototype.	<ol style="list-style-type: none"> 1. A pilot study was conducted to evaluate the effectiveness and performance of the system. 2. Quantitative data from the prototype system and qualitative data from questionnaires and videos were collected. 	Fully achieved	<ol style="list-style-type: none"> 1. The results of the pilot study were reported and published in an international conference ^. 	N.A.
To equip the occupational therapists and special teachers of the collaborating school with the skills to implement the proposed method, thereby by enabling them to promote the method to other schools in Hong Kong.	<ol style="list-style-type: none"> 1. Introduction and demonstration sessions were arranged for the collaborating school. 2. User manual of the prototype system was designed. 3. A website and leaflet for the project and were designed. 	Fully achieved	<ol style="list-style-type: none"> 1. A website was created for the project*. 2. A user manual of the prototype system and 300 copies of leaflets were made. 	N.A.

K.S. Choi, K.H. Lo. A virtual reality training system for helping disabled children to acquire skills in activities of daily living. The 14th International Conference on Computers Helping People with Special Needs (ICCHP 2014), Saint-Denis, France, July 9-11, 2014. Lecture Notes in Computer Science, vol. 8548, part II, pp. 244-251, 2014.
http://dx.doi.org/10.1007/978-3-319-08599-9_37.

^ K.S. Choi, V.C.L. Chiang. The outcomes of haptic visual reality training of activities of daily living for special school students with upper limb disabilities, International Conference on Health System Innovation, Hobart, Tasmania, Australia, 18 - 20 March 2015.

* Project Website: <http://myweb.polyu.edu.hk/~hskchoi/thomas/vrehab/index.html>



2. Project Impact

The project's effects on the learning effectiveness / professional development / school development should be evaluated, in evidence-based approach, with regard to:

- broadening students'/teachers' horizons
- increasing students'/teachers' sense of achievement
- fostering students' development in their potential and specific abilities
- training students to better meet social demands
- increasing training opportunities for teachers and enhancing their professional development
- improving learning atmosphere
- fostering team spirit and enhancing the overall image of the school
- inducing collaboration with other schools / professional organizations.

The computer-based system proposed for the training of activities of daily living (ADL) is a novel approach in occupational therapy. The novelty lies in (i) the availability of force/tactile feedback and (ii) the reproduction of real environments/tasks for the training, when compared to existing approaches where such feedback is not available and the training is dull and not directly related to real tasks. Force feedback is important for proprioception and can enhance training effectiveness, whereas simulating reality in the training is more lively and engaging, thus motivating the students to learn. The results from the pilot study shows that both the occupational therapists and the students were satisfied with the system.

The results from the pilot study also indicated that the students' performance in the computer-based training tasks had improved after repeated practice. A longer term study will be needed to determine "dosage", i.e. the amount of computer-based training, required to effectively transfer the skills learned in simulated environment into reality.

While the training of basic fundamental skills is necessary, the proposed system aims towards a more practical aspect, with the development of a computer-based training system, to facilitate disabled students to regain self-care ability, namely, their ability to cope with ADL. The system is a next step following the fundamental training, preparing the students to get closer to living independently by computer simulation before practicing with real materials. It is particularly meaningful if the ADL tasks involve risky operations, e.g. cutting food, which may hurt the students. With computer simulation, safety in training can be guaranteed.

The project and the proposed system make use of advanced technology in a relatively unexplored area in occupational therapy. The occupational therapists do have ideas to improve conventional training methods but may not be aware of, or familiar with the enabling technologies that can be capitalized to realize them. The project is thus a valuable opportunity to synergize occupational therapy and technologies, broadening the horizon of the therapists on the development of new approaches for rehabilitation. The occupational



therapists are eager to keep up enabling technologies, which are meaningful to their career development. They have gained insights into the use of the haptic technology in rehabilitation through participation in the project, and are able to come up with innovations ideas to improve the training methods.

The comment and feedback from the collaborating school and the occupational therapists on the project is positive. Further discussion has been underway on the investigations of the effectiveness of the proposed training system to substantiate the results and findings. The investigations will serve as support to promote the use of the system as a routine training approach in special schools. In this regard, more special schools will be approached to participate in the investigations. The collaborating school is the resource centre for all special schools in Hong Kong, it is in a good position to promote and advocate the proposed computer-based ADL training system.

3. Cost-effectiveness

Grantees are required to complete the 'Budget Checklist' at Table 2 in this Annex and enclose it as an appendix of this report. Please adopt the classification of budget items in Schedule II of the Agreement.

The total expense of the project is **\$291,368.20**. Details can be found from the **Budget Checklist** below.

Budget Items <i>(Based on Schedule II of Agreement)</i>	Approved Budget (a)	Actual Expense (b)	Change [(b)-(a)]/(a) +/- %
Staff Cost	\$267,750	\$267,750	0.0%
Equipment : Desktop computer	\$5,500	\$5,500	0.0%
Equipment: Graphics display card	\$1,000	\$1,000	0.0%
General Expenses: 3D Computer models, mechanical parts, tooling, promotional materials	\$9,150	\$4,235	-53.7%
General Expenses: Mobile workstation	\$7,000	\$6,250	-10.7%
General Expenses: Advertising fee for staff recruitment	\$500	\$0	-100.0%
General Expenses: Transportation	\$1,500	\$465	-69.0%
General Expenses: Audit Fee	\$5,000	\$5,000	0.0%
General Expenses: Desk mount LCD arm	\$1,400	\$1168.2	-16.6%

The project's cost-effectiveness should be evaluated with regard to:

- utilization of available resources (e.g. equipment, human resources of applicant school/ participating school(s))
- unit cost for the direct beneficiaries
- sustainability of the learning programme and materials developed
- expenditure items which require no injection of resources when the project is replicated by other schools (including setup cost of the project, deliverables ready for use)
- alternative approaches for equivalent benefits at less cost

The project had largely leveraged the expertise of the occupational therapists of the collaborating school to design and develop the computer-based training system. The therapists know exactly the needs of the students and the possible ways that assistance can be made available to support both the teachers and the students, to enhance the learning curve and the training effectiveness of the therapeutic approaches.

The project had also capitalized the machinery and tooling resources, as well as craftsmanship and IT support available from the collaborative school (e.g. in the design and installation of the mobile workstation), which were helpful to streamline the research and development of the computer-based training system, and the implementation for the pilot studies.

A critical hardware component of the computer-based training system is the pair of haptic devices. They were available from the institution with which the grantee is affiliated, and were on loan for the project.

The main expenditure of the project was on manpower. Staff member knowledgeable of the technologies and knowhow is essential to implement the concepts and ideas of the rehabilitation training and to meet the expected use of the computer system. The software system developed for the prototype system in the project is therefore a piece of valuable asset. Apart from the licensing cost and others, if any, the software can be replicated for every system to be developed.

When the software system is further developed and become more mature, the cost for replicating the computer-based system is primarily the purchase of hardware, i.e. computer, monitor, display card, mobile workstation and the pair of haptic devices. The hardware cost incurred is about HK\$75,000 per set.

The proposed computerization of the training of ADL tasks for disabled students offers a number of advantages: (i) *safety*, (ii) objective and *quantitative* evaluation, (iii) *flexibility* to adapt to disability of individuals (vary training needs and difficulty by programming), (iv) increased learning opportunity attributed to *reduced logistics and workload* and the possibility of *self-learning*, and (v) *engaging* students to practice with game-like interactive environments. Given these benefits, it is considered worthwhile to invest into the proposed approach and the like for the benefits of the needy students, who receive relatively less attention from the commercial society, for the population is comparatively small



and it represents a small yet niche market.

To reduce the cost of the project, a possible approach is to outsource the software development tasks of the computer-based training simulator, which is likely to reduce to overhead cost and the effort of project management. On the other hand, since the proposed system is not a product for the mass, it may not be easy to come up with a sustainable business model without substantially raising the unit price, which is in turn unfavorable to the disabled students. A possibility here is to seek philanthropic donation or charity fund to financially support the hardware of the training system for the benefits of the disabled students, or to approach suppliers of the hardware to offer special discount as manifestation of corporate social responsibility.

4. Deliverables and Modes of Dissemination

The following items should be included in the evaluation of each of the project deliverables and their value for dissemination (*the information may be presented in a table form in the format of Table 3 in this Annex*):

- description of the deliverable (e.g. type, title, quantity, etc.)
- evaluation of the quality and dissemination value of the deliverable
- the dissemination activities conducted (please state the date, mode, etc.) and the responses of the participants/recipients to such dissemination activities
- the value and feasibility for the deliverable to be widely disseminated by the QEF as well as suggested modes of dissemination.

Item description (e.g. type, title, quantity, etc.)	Evaluation of the quality and dissemination value of the item	Dissemination activities conducted (e.g. mode, date, etc.) and responses	Is it worthwhile and feasible for the item to be widely disseminated by the QEF? If yes, please suggest the mode(s) of dissemination.
Full paper, “A virtual reality training system for helping disabled children to acquire skills in activities of daily living”	The review process of the conference was very competitive. Only 132 out of the received 362 submissions were accepted full papers (36%); the paper presented the technical details of the project.	Presented the paper at the 2014 International Conference on Computers Helping People with Special Needs (ICCHP) Saint-Denis, France, July 9-11, 2014.	A seminar may be conducted to publicize the results of the projects to occupational therapists and special schools in Hong Kong.
Poster paper, “The outcomes of haptic visual reality training of activities of daily living for special school students with upper limb disabilities”	The paper presented the design, implementation and the results of the pilot research study in the project.	Presented the paper at the International Conference on Health System Innovation, Hobart, Tasmania, Australia, 18 - 20 March 2015.	



Project website	The website contains brief description of the projects, photos and videos, user manual, and press information.	A website was created in part for the project.	
Leaflet – to give a one-page brief description of the project		To be distributed to all special schools in Hong Kong.	
User manual		User manual of the prototype system was available from the Project Website.	

A brief description of the elements/experiences contributing to the success of the project and feasibility of continuing the project should also be given.

The factors contributing to the success of project include (i) the support of the collaborating school and the keen enthusiasm of the occupational therapists, (ii) concrete experience of the enabling technology – virtual reality and haptic feedback, (iii) human and material resources.

More evidence is needed to further substantiate the effectiveness of the proposed project. A large scale study involving more if not all special schools, for a longer study period, will be essential to achieve this goal. The feasibility of continuing the project will thus depend on the availability of resources for (i) coordinating and conducting the longer-term and larger-scale study, (ii) improving the prototype system, including functionalities, usability and robustness, (iii) duplicating the system for multiple schools; and (iv) the enthusiasm of the special schools – which is quite promising based on the successful collaboration in this project and the constructive and positive feedback obtained from the occupational therapists and students.

5. Activity List

Particulars of activities conducted during the project period such as types of activities, brief descriptions of the activities, number of participants and feedback from participants should be reported (*the information may be presented in a table form in the format of Table 4 in this Annex or in short paragraphs*).

Types of activities (e.g. seminar, performance, etc.)	Brief description (e.g. date, theme, venue, etc.)	No. of participants				Feedback from participants
		schools	teachers	students	others (Please specify)	
Introductory session	15 May 2013, PAS	1	9		8	The participants (9 occupational therapists and 8 assistants) The idea of the project was well received by the participants. They learned about the concepts, methods of the project and how the system would be implemented and evaluated.
Demonstration session	9 Sep 2013, PAS	1	9		8	The participants (9 occupational therapists and 8 assistants) evaluated the prototype system and appreciated the functionality. Explanation about the set up and operations were given. They provided useful comments which were important to further enhance the usability.
Pilot study (Part 1)	12-13 May 2014, PAS	1	9	26	4	Student satisfaction was generally good and their exertion level was mainly low. Feedback of teachers (i.e. the occupational therapists) was positive and their impression of task performance improvement in reality was good.
Pilot study (Part 2)	9-20 June 2014, PAS	1	9	23	4	ditto

N.B. PAS = The Hong Kong Red Cross Princess Alexandra School



6. Difficulties Encountered and Solutions Adopted

The information here should explain why the actual project implementation (including the budget, schedule and process) differs from the original plan, if applicable.

The project spent a total of \$291,368.20, which was well within the budget \$298,000. The unspent amount is \$7493.18. Some unforeseen but required items were not budgeted (e.g. a more powerful computer system, materials for better system design) at the time when the proposal was prepared. With the support and approval of QEF, the items were acquired eventually by making change-of-budget requests. The cost of some of the required items, i.e., the computer and display card, were above the standard cost set by the QEF. They were still purchased as it did require more powerful models in order to meet the requirement of the computer-based training system. The outstanding cost was covered by the grantee personally.

The project duration was extended from the original end date 31 March 2014 by 9 months to 31 December 2014. It was because the project was initially delayed due to difficulty in staff recruitment. In turn, rescheduling was also required to fit in the teaching schedule of the collaborating school and thus the original plan for pilot field trials and other activities were also affected. The extension allowed for more time and flexibility for field trials and system evaluation.