RGC Ref. No.:
UGC/FDS17/M03/20

(please insert ref. above)

RESEARCH GRANTS COUNCIL
COMPETITIVE RESEARCH FUNDING SCHEMES FOR
THE LOCAL SELF-FINANCING DEGREE SECTOR

FACULTY DEVELOPMENT SCHEME (FDS)

Completion Report
(for completed projects only)

Submission Deadlines:	1. *Auditor's report with unspent balance, if any: within **six** months of the approved project completion date.*
	2. *Completion report: within **12** months of the approved project completion date.*

Part A: The Project and Investigator(s)

1.   Project Title

Efficacy of biofeedback-controlled game-based swallowing training (BGBST) in stroke

survivors

2.   Investigator(s) and Academic Department(s) / Unit(s) Involved

| Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr. YIP Chi-kong / Associate Professor	School of Medical and Health Sciences, Tung Wah College
Co-Investigator(s)	Mr. Chiu Tat-sun / Occupational Therapist I	Kowloon Home for the Aged Blind, The Hong Kong Society for the Blind
Co-Investigator(s)	Dr. Wong Winsy Wing-sze / Research Assistant Professor	Department of Chinese and Bilingual Studies, Faculty of Humanities of The Hong Kong Polytechnic University.

3.   Project Duration

	Original	**Revised**	**Date of RGC / Institution Approval** *(must be quoted)*
Project Start Date	1st JAN 2021		
Project Completion Date	31st DEC 2022	30th JUNE 2023	23rd NOV 2022
Duration *(in month)*	24 months	30 months	
Deadline for Submission of Completion Report			

4.4   Please attach photo(s) of acknowledgement of RGC-funded facilities / equipment.

VitalStim Plus   Rephagia sEMG sensors
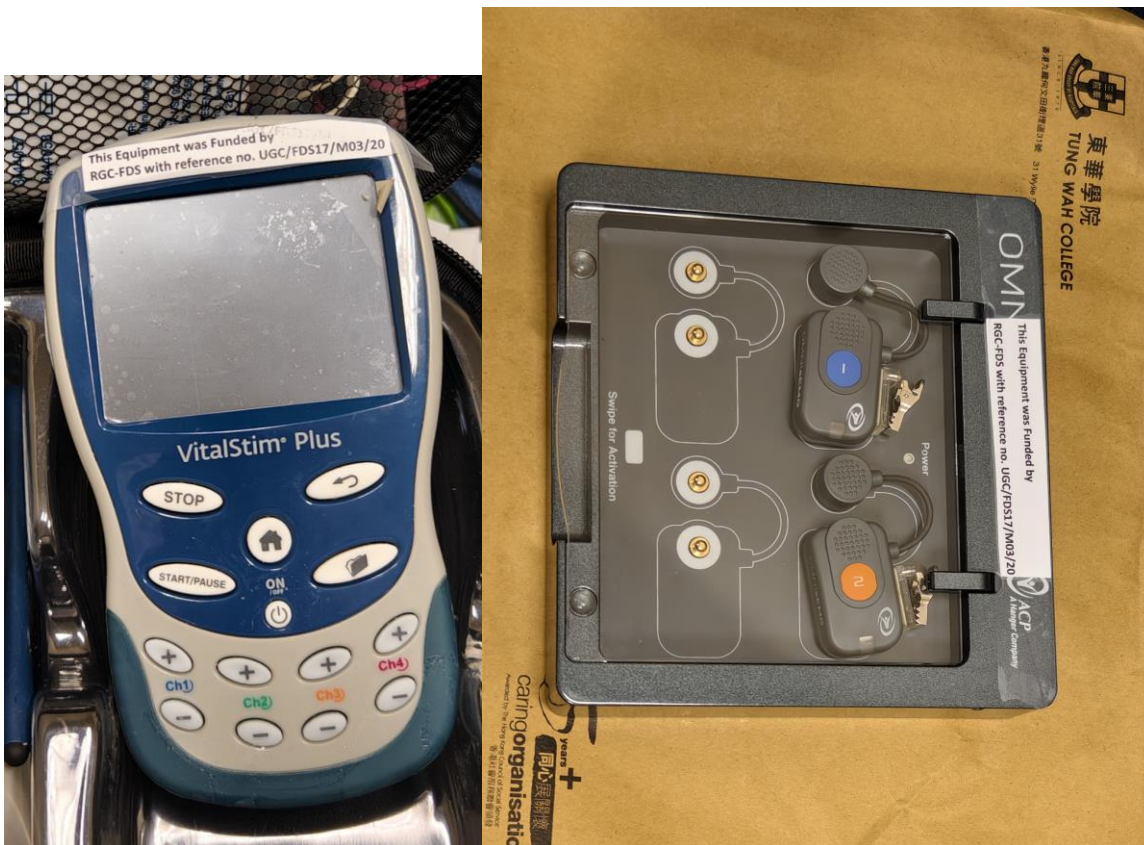
Part B: The Final Report

5.   Project Objectives

5.1   Objectives as per original application

1.To evaluate the effectiveness of biofeedback game-based swallowing training (BGBST) in improving the strength of the suprahyoid muscle group in stroke survivors relative to control subjects.
2. To evaluate the effectiveness of BGBST in improving participation in and quality of swallowing after the intervention.
3. To develop the laboratory skills of undergraduate students in swallowing training and the application of sEMG.

5.2   Revised objectives

Date of approval from the RGC:

Reasons for the change:

1.

2.

3. ....

5.3   Realisation of the objectives
(Maximum 1 page; please state how and to what extent the project objectives have been achieved; give reasons for under-achievements and outline attempts to overcome problems, if any)

The objective 1 was achieved by evaluating the progress of the participants who received biofeedback game-based swallowing training (BGBST) in terms of their suprahyoid muscle surface Electromyography (sEMG) activities during swallowing different texture of foods and 3 months afterward. The result was presented in one local conference and two international conferences.

The objective 2 was accomplished by evaluating the quality of swallowing through measures such as the EAT10 scale and assessing the participants' level of engagement in feeding activities. The result was presented in one local conference and two international conferences.

The Objective 3 involved the training of undergraduate students in assessing swallowing disorders and providing swallowing training. This objective was successfully achieved, as demonstrated by the students' accurate application of sEMG and dysphagia assessment in completing a project related to swallowing evaluation. The students successfully finished a capstone project aimed at investigating the normative sEMG values for healthy individuals when swallowing different levels of food textures according to the International Dysphagia Diet Standardization Initiative (IDDSI) framework.

Throughout the project, we encountered a significant obstacle - the COVID-19 pandemic. The global impact of COVID-19 resulted in a delay of 6 months in obtaining the necessary study equipment. Additionally, the closure of social and elderly centres posed challenges in recruiting subjects for both centre-based and home-based BGBST training. Furthermore, people hesitated to participate in the study due to the requirement of removing face masks and consuming different food textures during the BGBST.

To address these challenges, we shifted our target to resident elderly homes. These facilities operated in a closed-circuit environment, our co-Investigators and part-time research assistant were staffs within these residential elderly homes. This enabled them to contact and recruit elderly residents for training and study participation. As the severity of the pandemic subsided, we resumed recruitment from the community; however, we still faced difficulties in the recruitment process.

Despite these obstacles, we persevered and adapted our approach to ensure the continuity and progress of the study.

We strict adherence to safety protocols and guidelines was enforced to protect both the research assistant and the subjects. Fortunately, the BGBST session required only face to the operating computer instead of people, thus, we did it in a clen room with only the subject removing the mask for eating different food textures. Moreover, feeding utensils were sanitized after each use to maintain safety and well-being of the RA and subjects.

To overcome the challenges posed by the pandemic and the subsequent delays, we applied for a project timeline extension of 6 months to allow for the completion of all project objectives.

5.4   Summary of objectives addressed to date

Objectives *(as per 5.1/5.2 above)*	Addressed *(please tick)*	Percentage Achieved *(please estimate)*
1. To evaluate the	✓	100% Achieved

effectiveness of biofeedback game-based swallowing training (BGBST) in improving the strength of the suprahyoid muscle group in stroke survivors relative to control subjects.		
2. To evaluate the effectiveness of BGBST in improving participation in and quality of swallowing after the intervention.	✓	100% Achieved
3. To develop the laboratory skills of undergraduate students in swallowing training and the application of sEMG.	✓	100% Achieved

6. Research Outcome

6.1 Major findings and research outcome
(Maximum 1 page; please make reference to Part C where necessary)

The computerized biofeedback game-based swallowing training (BGBST) enables subjects to have better control over the localized suprahyoid muscle through the implementation of biofeedback and sEMG-controlled tasks.

The project recruited a total of 72 subjects from 3 elderly centres and were randomly divided into a training group (n=37) and a control group (n=35).

The training group received the computerized biofeedback game-base swallowing training (BGBST) thrice a week for three weeks. The control group received swallowing training as usual for 3 weeks. Then we follow up and reassessed their condition again 3 months later.

The mean age of the participants was 83.25 years (SD=8.57), and there was no statistical difference in age between the training and control groups. The post-stroke duration ranged from 2 to 22 years, with a median of 10 years and a mode of 2 years. In terms of education level, 48.3% had primary education, 34.5% had no formal education, and 17.2% had secondary or tertiary education.

We found that there were significant differences in average sEMG and the peak sEMG of suprahyoid muscle during swallowing of IDDSI level 0,2, and 4 food texture between the training and control groups. These findings indicate that after training, there were significant differences in the activities of the suprahyoid muscles involved in swallowing, suggesting increased in suprahyoid muscle strength.

In both training and control groups, there were significant differences in the average sEMG and the peak SEMG over time (baseline assessment, post training assessment and follow up), indicating the impact of training on the suprahyoid muscles increase in the training period but drop back to the baseline with the training stop for three months. Therefore, it is recommended that clients engage in training three times per week at monthly intervals to maintain the desired effects.

The study results demonstrated that even post-stroke for 10 years, intensive training can effectively mitigate muscle deterioration. This finding suggests that consistent training can counteract muscle atrophy and maintain or improve swallowing function over an extended period.

The study results also highlighted that the effects of training were more pronounced in individuals requiring IDDSI level 4 texture for feeding, indicating severe dysphagia. In comparison, those with milder dysphagia requiring IDDSI level 0 or 2 had less prominent effects. This finding emphasizes the importance of tailoring interventions based on the severity of dysphagia.

In conclusion, this study demonstrated that the BGBST had significant positive effects on swallowing muscle activities in the post-stroke elderly population. It is a feasible swallowing training during the shortage of manpower or isolation measures. It was an alternative method when face-to-face training was not feasible during COVID-19. Moreover, the BGBST protocol is effective, especially for the clients with prescribing food texture at IDDSI level 4.

The findings support the implementation of intensive training programs to improve swallowing function, particularly in individuals with severe dysphagia in the elderly resident home.

6.2 Potential for further development of the research and the proposed course of action
(Maximum half a page)

Based on the project results, we propose further development in the following areas:

1. Exploring the efficacy of BGBST in diverse participant groups, specifically, evaluating the effectiveness of BGBST in people with Parkinson's disease and those with Nasopharyngeal carcinoma, as these populations have a higher likelihood of experiencing dysphagia. By assessing the benefits of BGBST in these specific groups, we can expand its potential applications and tailor the training to address their unique needs.

2. Exploring the integration of BGBST into telehealth platforms: This development would involve seamlessly incorporating BGBST into telehealth platforms, allowing individuals to access training and support remotely. By enabling remote access to BGBST, we can enhance the accessibility and convenience of swallowing therapy for individuals in need. This integration holds promise for individuals with swallowing difficulties who face challenges related to travel, physical limitations, or limited access to specialized healthcare services.

These proposed areas of further development have the potential to advance the field of swallowing therapy, expanding its reach and effectiveness in diverse participant groups while improving accessibility through remote training and support.

7. Layman's Summary
(Describe <u>in layman's language</u> the nature, significance and value of the research project, in no more than 200 words)

本研究發現使用生物返饋遊戲的吞嚥訓練(BGBST)，吞嚥困難患者得以更好地掌控吞嚥肌肉(舌骨上肌)的控制，從而達到更有效之訓練效果。本研究由72位患有中風及不同程度吞嚥困難之長者參與為期三星期，每星期三節之BGBST訓練。發現即使在中風後的10年裡，BGBST能增加參與者舌骨上肌之力量及協調性，從而改善吞嚥困難的程度。其結果還發現對於需要進食IDDSI等級4的患者，訓練的效果更為顯著。

總結起來，BGBST訓練對中風後及有吞嚥困難之長者的吞咽有顯著的訓練效果。在人力短缺或隔離措施下(尤在COVID-19期間)，這是一種可行的吞咽訓練方法，它是一種替代方法。

Part C: Research Output

8. **Peer-Reviewed Journal Publication(s) Arising Directly From This Research Project**
   (Please attach a copy of the publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.)

| The Latest Status of Publications | | | | Author(s) *(denote the corresponding author with an asterisk*)* | Title and Journal / Book *(with the volume, pages and other necessary publishing details specified)* | Submitted to RGC *(indicate the year ending of the relevant progress report)* | Attached to this Report *(Yes or No)* | Acknowledged the Support of RGC *(Yes or No)* | Accessible from the Institutional Repository *(Yes or No)* |
Year of Publication	Year of Acceptance *(For paper accepted but not yet published)*	Under Review	Under Preparation *(optional)*						
Nil.									

9. **Recognized International Conference(s) In Which Paper(s) Related To This Research Project Was / Were Delivered**
   (Please attach a copy of each conference abstract)

Month / Year / Place	Title	Conference Name	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this Report *(Yes or No)*	Acknowledged the Support of RGC *(Yes or No)*	Accessible from the Institutional Repository *(Yes or No)*
NOV/22/ HK	Computerized biofeedback game-base swallowing training (BGBST) for dysphagia after stroke in elderly residential home during COVID-19	29th Annual Congress of Gerontology, Hong Kong Association of Gerontology	NO	YES	YES	NO

JUL/23	Effectiveness of biofeedback game-base swallowing training (BGBST) for dysphagia after stroke in elderly residential home	The 8th China Dysphagia Summit	NO	YES	YES	NO
DEC/23	Computerized biofeedback game-base swallowing training (BGBST) for dysphagia after stroke in elderly residential home during COVID-19	Hong Kong Occupational Therapy Association 45th Anniversary OT Conference	NO	YES	YES	NO
NOV/24	sEMG biofeedback game-base swallowing training (BGBST) for dysphagia after stroke in elderly residential home during COVID-19	8th Asia Pacific Occupational Therapy Congress 2024	NO	NO	NO	NO

10. Whether Research Experience And New Knowledge Has Been Transferred / Has Contributed To Teaching And Learning

(Please elaborate)

The research experience has made significant contributions to the teaching of BSc (OT) discipline subjects, namely OCC3002 Enabling Occupation - Health Care II, OCC3010 Applied Research Methodology in Rehabilitation Science, and OCC4001 Capstone Project. Specifically, the utilization of physiology markers as outcome indicators to aid therapists in treatment planning and monitoring clients' progress in oral feeding rehabilitation has been incorporated into lecture and tutorial sessions of OCC3002. The research methodology, selection of outcome indicators, and the project's results demonstrating treatment effectiveness have been integrated into the curriculum of OCC3010.

Moreover, this project has served as an inspiration for students to pursue their own capstone projects (OCC4001) related to the use of surface electromyography (sEMG) and swallowing. Two notable capstone projects have emerged from this inspiration. The first project, titled "Suprahyoid Muscle Activities and Thickness of Tongue during Swallowing of Different Food Textures in Healthy Adults - An Exploratory Study," has been completed. The second project, titled "sEMG of Suprahyoid Muscles in Swallowing Different Food Textures for People with Parkinson's Disease," is currently ongoing.

These initiatives have not only enriched the academic discourse surrounding the BSc (OT) discipline but have also fostered a sense of innovation and engagement among students in their pursuit of research and practical application.

11. Student(s) Trained
(Please attach a copy of the title page of the thesis)

Name	Degree Registered for	Date of Registration	Date of Thesis Submission / Graduation
████████	Bachelor of Science (Honours) in Occupational Therapy	1 SEPT 2018	30 MAY 2022
████████	Bachelor of Science (Honours) in Occupational Therapy	1 SEPT 2018	30 MAY 2022
████████	Bachelor of Science (Honours) in Occupational Therapy	1 SEPT 2018	30 MAY 2022

12. Other Impact
(e.g. award of patents or prizes, collaboration with other research institutions, technology transfer, teaching enhancement, etc.)

13. Statistics on Research Outputs

	Peer-reviewed Journal Publications	Conference Papers	Scholarly Books, Monographs and Chapters	Patents Awarded	Other Research Outputs (please specify)	
No. of outputs arising directly from this research project	0	2*	0	0	Type	No.

*The pilot results of this project were presented at the HKAG and HKOTA conferences, while the full results were presented at the 8th China Dysphagia Summit. Additionally, the full results will be presented at the upcoming 8th Asia Pacific Occupational Therapy Congress 2024. Although there were differences in the results between the pilot and completed project, the objectives, methodology, and conclusions remained the same. As a result, the project has yielded two research outputs.

Public Access Of Completion Report

(Please specify the information, if any, that cannot be provided for public access and give the reasons.)

Information that Cannot Be Provided for Public Access	Reasons
No	