

RGC Ref. No.:
UGC/FDS15/E02/20
(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

Developing and Validating Cloud intelligence Assessment System on Identification on Developmental Dyslexia of Chinese Language

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr YUEN Connie Man-ching / Associate Professor and Head	Department of Applied Data Science / Hong Kong Shue Yan University
Co-Investigator(s)	N/A	N/A
Others	N/A	N/A

3. Project Duration

	Original	Revised	Date of RGC / Institution Approval (must be quoted)
Project Start Date	01 - Jan - 2021	N/A	N/A
Project Completion Date	31 - Dec - 2022	31 - Dec - 2023	20 – June – 2023 (by RGC)
Duration (in month)	24 months	36 months	20 – June - 2023 (by RGC)
Deadline for Submission of Completion Report	31 - Dec - 2023	31 - Dec - 2024	20 – June - 2023 (by RGC)

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

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. To develop a machine-learning-based assessment system on a cloud platform. The proposed assessment system can be used by different stakeholders, such as teachers, parents, and educational psychologists, as a fast and easy way of identifying children with developmental dyslexia where traditional Chinese characters are concerned;
2. To examine the machine-learning classifiers for identifying dyslexia. This is to overcome the limitations in the existing works on the subject, which only consider a few machine-learning classifiers for identifying dyslexia where simplified Chinese characters are concerned, but not where traditional Chinese characters are concerned, where it is much more difficult to distinguish between people with dyslexia and those without);
3. To extract the key features that can improve the performance of machine-learning classifiers for identifying dyslexia. This is to address the gap in existing studies on the subject since none of these have extracted key features to improve the performance of machine-learning models in terms of both prediction accuracy and processing time;
4. To examine the metrics for identifying dyslexia and discover those that are better at differentiating between those with dyslexia and those without;
5. To work with NGOs serving people with dyslexia by forming an advisory committee to provide advice on designing the project and help promote public awareness of dyslexia;
6. To collect data from the assessment system that researchers can use to analyse the performance of people with dyslexia and enrich their understanding of how to identify people with dyslexia, especially where traditional Chinese characters are concerned.

5.2 Revised objectives

Date of approval from the RGC: N/A

Reasons for the change: N/A

- 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)

- This project will design, develop and verify an intelligent dyslexia assessment system on the cloud.
- [Objective 1] We have designed and developed the mobile app for early identification system of dyslexia. We have designed and developed the cloud-based system for model training and data analysis. We have implemented a combination of different machine learning algorithms as the learning model in the server for data analysis.
- [Objective 2] We have examined the machine-learning classifiers for identifying dyslexia, especially for traditional Chinese characters. The more the training data collected, the better examination on the classifiers. However, the sample size of training data is not high enough.
- [Objective 3] We have examined the features that can improve the performance of machine-learning classifiers for identifying dyslexia in order to improve the performance of machine-learning models in terms of both prediction accuracy and processing time. The more the training data collected, the better examination on the features that can reflect the writing performance of children. However, the sample size of training data is not high enough.
- [Objective 4] We have examined the metrics for identifying dyslexia and discover those that are better at differentiating between those with dyslexia and those without. The more the training data collected, the better examination on the metrics. However, the sample size of training data is not high enough.
- [Objective 5] To work with NGOs serving people with dyslexia by forming an advisory committee to provide advice on designing the project and help promote public awareness of dyslexia. We have formed an advisory committee including 8 experts are kindergarten teachers, SEN early education teachers, occupational therapists, educational psychologists, clinical psychologists. PI and her research team have regular monthly meetings with the advisory committee. Two site visits of the early education training centres are conducted during the project period.
- [Objective 6] We have designed and developed a set of 3-page worksheets including selected representative words for Hong Kong children aged 5-6 for data collection for data collected. The training data collection process breaks into two sessions, so that we collected data from students of three cohorts. It is different from our proposal, in which we collect all data from students of one cohort only. We have retrieved the handwriting images from the collected dataset successfully for building models.
- We have retrieved the handwriting images from the collected dataset successfully. Preliminary experimental results are presented in a conference paper. I am still preparing the extended version of the conference paper including detailed experimental results.

5.4 Summary of objectives addressed to date

Objectives <i>(as per 5.1/5.2 above)</i>	Addressed <i>(please tick)</i>	Percentage Achieved <i>(please estimate)</i>
1. To develop a machine-learning-based assessment system on a cloud platform. The proposed assessment system can be used by different stakeholders, such as teachers, parents, and educational psychologists, as a fast and easy way of identifying children with developmental dyslexia where traditional Chinese characters are concerned;	√	90%
2. To examine the machine-learning classifiers for identifying dyslexia. This is to overcome the limitations in the existing works on the subject, which only consider a few machine-learning classifiers for identifying dyslexia where simplified Chinese characters are concerned, but not where traditional Chinese characters are concerned, where it is much more difficult to distinguish between people with dyslexia and those without);	√	70%
3. To extract the key features that can improve the performance of machine-learning classifiers for identifying dyslexia. This is to address the gap in existing studies on the subject since none of these have extracted key features to improve the performance of machine-learning models in terms of both prediction accuracy and processing time;	√	70%
4. To examine the metrics for identifying dyslexia and discover those that are better at differentiating between those with dyslexia and those without;	√	50%
5. To work with NGOs serving people with dyslexia by forming an advisory committee to provide advice on designing the project and help promote public awareness of dyslexia;	√	100%
6. To collect data from the assessment system that researchers can use to analyse the performance of people with dyslexia and enrich their understanding of how to identify people with dyslexia, especially where traditional Chinese characters are concerned.	√	90%

6. Research Outcome

6.1 Major findings and research outcome

(Maximum 1 page; please make reference to Part C where necessary)

Major findings:

- We designed a combined model for fast identification of dyslexia in Chinese Language for producing the prediction result (high risk or no risk) in dyslexia for each character. By comparing different baseline models, the accuracy of the combined model on predicting the possibility of having dyslexia is over 90% to the result evaluated by experts.

Research outcome:

- An intelligence system for early identification on developmental dyslexia of Chinese Language is built up. A conference paper introducing the system was presented.
- A web-based training platform with some AR games for dyslexic children is built up. A conference paper introducing the system was presented.
- An immersive game for write training is built up. A conference paper introducing the immersive game was presented.
- A seminar introducing the mobile app was held in Apr 2023. The mobile app was introduced and presented in a number of exhibitions, such as exhibitions in HKSTP event, Info Day 2022 and 2023, InnoEx 2024 in HKCEC. It helps to increase public awareness and importance of early identification of dyslexia.

6.2 Potential for further development of the research and the proposed course of action

(Maximum half a page)

- More training data should be collected to better identify the features for distinguishing between dyslexic children and non-dyslexic children.

7. Layman's Summary

(Describe in layman's language the nature, significance and value of the research project, in no more than 200 words)

- Detecting dyslexia is the first step toward clinical or teaching intervention for the children with dyslexia.
- In this project, we built up an intelligence system for early identification on developmental dyslexia of Chinese Language, a web-based training platform with some AR games for dyslexic children, and an immersive game for write training.
- The assessment systems can be used by assessment centres, teachers and parents to have a simple and fast way to identify developmental dyslexia.

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)						
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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)
07/ 2022/ Lisbon, Portugal	Design an Intelligence System for Early Identification on Developmental Dyslexia of Chinese Language	19th International Conference on Wireless Networks and Mobile Systems (WINSYS 2022).	No	Yes (Attachment 1)	Yes	Yes
01/ 2023/ India	Web-based Training Platform with AR Games for Dyslexic Children	The 2023 15th International Conference on Communication Systems & Networks (COMSNETS)	No	Yes (Attachment 2)	Yes	Yes
06/ 2023/ Hong Kong, China	“Fun2Write” Portable Immersive Environment Application	Positive Technology International Conference 2023 (PT 2023)	No	Yes (Attachment 3)	Yes	Yes

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

Some students from BSc(Hons) in Applied Data Science worked as student helpers to introduce and demonstrate projects during seminar.

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
N/A	N/A	N/A	N/A

12. Other Impact

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

The system developed in this project has been presented to some NGOs and will be adopted and promoted among some kindergartens and training centers.

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	3	0	0	Type	No.
					Seminar	1

14. 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
N/A	