優質教育基金
Quality Education Fund

M:FR/E

Final Report of Project	**Project No. : 2013/0448**

Part A

Project Title: Facilitating Creative Science with New Technologies

Name of Organization/School: Queen's College

Project Period: From 12/2014 *(month/year)* to 11/2016 *(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: 28-2-2017 Date: 28-2-2017

** 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.*

Project Title: Facilitating Creative Science with New Technologies

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Project Period: From 12/2014 *(month/year)* to 11/2016 *(month/year)*

1. Attainment of objectives

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
1. To launch a curriculum reform in junior Science 2. To provide students with practical-based science education 3. Introduction of new technology in science 4. To nurture students with enthusiasm of science	A. Lesson • Three 3D printing learning topics were implemented in the junior science curriculum. • Three coding tasks were conducted as project learning. • Two long-term investigations were performed at the new outdoor laboratory. • One interactive learning topic was carried out during the lesson using the newly purchased notebook computers. B. 3D printing workshop • Thirty 3D printing ambassadors were recruited to have trainings on 3D drawing, 3D printing process as well as 3D printer assembling skills. They were responsible for promoting the 3D printing technology to the others. • Meanwhile, all S2 students (2015-16) have attended a 3D printing introduction workshop. C. Exhibition • 3D printing technology has been showcased in the Integrated Science curriculum in teaching. D. Competition • Talented students interested in coding were nominated to participate in interschool competitions for more opportunities for applying the knowledge.	Fully achieved	From the data of the student questionnaire: 1. Over 80% of the students know how to draw 3D images by using related software or apps. They also know how to change the 3D image file (stl file) into 3D printing file (gcode). 2. Over 80% of the students have confidence to build a robot by using the core set. They also have confidence to write programme for controling the robot. 3. Over 90% of the S2 students know how to prepare algal balls by using the molecular technology. 4. Over 80% of the students agree that the school based Integrated Science curriculum (with the introduction of new science technology) enhance their enthusiasm for science.	/

2. Project impact on learning effectiveness, professional development and school development

Learning effectiveness:

Comparing with the tradition learning; students can better consolidate their science knowledge through the application of 3D printing technology.

For example, the students used the 3D drawing techniques to create a rib cage model. They needed to determine the size and the design for the components of the model, and drew them with the use of 3D drawing apps. Then, they printed them out using the 3D printer. Finally, they assembled all the component parts to construct their own rib cage model. Teachers could then use such model to explain the human breathing mechanism. As students have done detailed planning in designing the model, they could quickly understand the underlying principles of breathing mechanism.

In addition, a super creature model was created in another project. Students acquire the knowledge of living things and classification through textbook and teacher's explanation in traditional lesson plans. By implementing the 3D printing technology in this project, students could fully explore their creativity to design a super creature which could adapt to a particular habitat. Student could learn through higher order thinking and applying scientific knowledge.

Moreover, students have learnt coding and did invention through the use of [redacted] core set in science lessons. In the project "Robotics application: Leading us to a better future", students could further employ these knowledge in making their products through self-directed learning approach, with the aims of self-planning, self-monitoring, self-evaluation and self-revision, in their whole learning journey. They set their own goal to create a helping robot. According to our evaluation, students enjoyed this learning approach with the sense of achievement and satisfaction. Our school has also shared this experience with other schools in the event of "Young Scientist Party" [redacted], and received "the Outstanding Team Award" in the field of Self-directed Learning in Scientific Investigation.

Professional development

Our school have received financial supports for the STEM education which surely enhances our department to undertake school-based curriculum reform to provide quality STEM education. 3D printers, notebook computers [redacted] core sets purchased with the funding were used in conducting more interactive lesson activities, which helped achieve STEM teaching in each class. Every student could learn science through our tailor-made STEM Curriculum.

With respect to teachers' professional development, this curriculum reform enabled the Integrated Science subject teachers to learn new technology. They became the pioneer of the school to introduce STEM to other teachers for the knowledge and the application (e.g. Odyssey of Mind Competition).

School development:

The school could make use of higher technology to teach science. Also, through the presentation and exhibition of our school-based Integrated Science curriculum to the public, our school has gained more reputation and reward. For example, in the event of "Young Scientist Party" [illegible], our school has won "My Favorite Booth Golden Award".

3. Cost-effectiveness – a self-evaluation against clear indicators and measurees

Budget Items *(Based on Schedule II of Agreement)*	**Approved Budget (a)**	**Actual Expense (b)**	**Change [(b)-(a)]/(a) +/- %**
Equipment	$135,000	$120,107.4	-11.0%
General expenses	$5,000	$4,000	-20%

4. Deliverables and modes of dissemination; responses to 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.**
Three teaching rundowns with learning outcome of our school-developed science /STEM project were shared on [illegible] webpage	As we have integrated the STEM education into the self-directed learning approach. This experience could inspire other schools to develop new plans in their curriculum.	The teachers of participating schools (around 30 primary and secondary schools) could access the teaching materials for reference.	No
3D Printing Workshop for science teachers	As the school has developed a few 3D printing science activities in lessons, it was worth sharing with other science teachers for their professional development.	Our school participated in the STEM Education Conference-cum-Carnival [illegible] on 16th December, 2016. The topic shared was "3D printing in IS curriculum". More than 100 teachers visited our booth for more information about STEM.	Our activities related to the Integrated Science curriculum which provided information not illustrated by the professional development programme. It was worth sharing to facilitate the STEM education development in Hong Kong.

5. Activity list

a) The school year 2014-2015 (From Dec 2014)

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)	
1. Project (Robotic Tech 1)	March 2015	1	2	144 (S1)		• Students were excited to use the and learn coding.
2. Daffodil experiment	Outdoor lab (QC)	1	2	144 (S1)		• Students enjoyed this scientific investigation journey.
3. Solar car competition	4/2/2015	1	2	144	2 (Advisors)	• Students could make good use of their creativity in their solar car design and applied the concept of energy-saving in this project.
4. Scientific invention	May 2015	1	2	144 (S1)		• Students could integrate their scientific knowledge to invent a new product. • This project is innovative.

b) The School year 2015-2016

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)	
5. Discover Engineer Workshop	• 13/11/2015 • 1330-1530	1	2	144 (S2)		• This innovative activity attracted students' attention. • The airplane making and competition session were practical.
6. Self-directed learning project (Tomato seedling experiment)	• Nov 2015 • Ten lessons for each class • Outdoor lab (QC)	1	2	144 (S1)		• Students appreciated the chance of growing tomato plants starting from seed and setting their hypothesis for investigation.
7. Workshop (Use of 3D printer)	• 3/12/2015 (2 hrs) • 22/12/2015 (2 hrs) • 20/1/2016 (2 hrs)	1	2	30 (S2)		• Students learned 3D drawing and printing quickly and requested for more chances of using a 3D printer.
8. Exhibition – 3D printer (Student Education Fair on Science Technology and Mathematics)	• 22-23/1/2016 • 1000 – 1700 • Hong Kong Science Park	1	4	17 (S2)	(300) visitors	• Students were proud of knowing how to use a 3D printer. They showed high motivation and enthusiasm to introduce this technology to the public. • Some high achievers even searched for additional information of the 3D printing and produced some products themselves and shared with the guests.
9. Exhibition – 3D printer (QC Open Day)	• 29-30/1/2016 • 1000 - 1700	1	2	10 (S2)	(300) visitors	
10. Exhibition – 3D printer (QC S1 Admission Interview Day)	• 19/3/2016 • 1000 - 1600	1	2	10 (S2)	(100) visitors	
11. Self-directed learning project (Robotics application- leading us to a better future)	• April, May 2016 • Ten lessons for each class	1	2	144 (S1)		• After this project, they realized LEGO robot making could help people to solve many problems in daily life. • Students had a chance to work on their own by self-directed learning.

12. Workshop (Assembly of 3D printer)	• 29/4/2016 (2.5 hrs) • 20/5/2016 (2.5 hrs) • 24/5/2016 (2.5 hrs)	1	1	10 (S2)		• Our students were amazed by building the 3D printers on their own. • Students enjoyed this kind of training in engineering. • The assembling of our own 3D printers was a milestone of STEM education in our school.
13. Interactive learning (Use of software for online field study)	• May 2016 • Three lessons for each class	1	2	144 (S1)		• Students enjoyed learning through this software.
14. Workshop (3D drawing and 3D printing)	• 5-6/7/2016 (2.5 hrs)	1	1	144 (S2)		• This workshop was practical for learning 3D printing technology.
15. Robotics Intelligence DIY Competition	• 7/7/2016 • 0900 – 1800 • Hong Kong Space Museum	1	1	3 (S1)		• The tasks were challenging. • Students requested for participating in this competition again in next year.
16. Exhibition and presentation (Robotics) (Young Scientist Party)	• 9/7/2016 • 0930 – 1300 •	1	4	20	100 (Visitors)	• Students were honoured to share our project with other schools. • They have won two awards.

b) The school year 2016-2017 (Up to Nov 2016)

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)	
17. Lesson (3D drawing and printing – mini conical flask)	• Sept 2016 • Two lessons for each class	1	2	144 (S1)		• Students were interested to learn how to use a 3D printer. • Every student made a mini conical flask for themselves.
18. Lesson (3D drawing and printing – rib cage model)	• Nov 2016 • Three lessons for each class	1	2	144 (S2)		• This topic was practical and useful for illustrating the concepts.
19. Self-directed learning project – 3D drawing and printing (Design a super creature)	• Nov 2016 • Ten lessons for each class	1	2	144 (S1)		• Students enjoyed the integrated tasks which designed their own super creature based on their setting goal.
20. Self-directed learning project (Automatic watering robot)	• Oct 2016 (Not yet completed)	1	2	144 (S2)		• This is a challenging task for students.
21. Algal ball experiment	• Oct 2016	1	2	144 (S2)		• Students were keen to conduct this experiment in relation to the molecular gastronomy. • Students could bring the algal ball home for further observation. • This experiment was practical for illustrating the concepts of gaseous exchange in plants.
22. Interactive learning (Use of software for online field study)	• Nov 2016 • Two lessons for each class	1	2	144 (S1)		• Some students spent 2-3 hours to complete an online task at home (Construction of a food web).

6. Difficulties encountered and solutions adopted

	Difficulties	Solutions
1	The original project leader, was allocated to other school. A new teacher took up the remaining parts of the project from 1 Sept, 2015. There was changes in the original teaching plan.	Our Integrated Science teachers worked very hard to learn new technology. We were willing to try some new topics (e.g. Designing a super creature, Algal ball experiment) and made integration to the current subject curriculum.
2	The teaching time was scarce. We might not complete the whole syllabus after adopting some STEM elements in the normal lessons.	We adopted the self-directed learning approach in Integrated Science. Not only there was more time to perform STEM activities, students' motivation in learning and scientific investigation were also boosted.
3	Student participation might not be enough if there was one 3D printer in the laboratory.	Eight small size 3D printers were purchased finally to support the group-based practical works.
4	There is limited reference for developing the STEM topics that were related to our current Integrated Science curriculum.	Teachers attended seminars/workshops frequently to update STEM education information.