Quality Education Fund

The Dedicated Funding Programme for Publicly-funded Schools

Part B: Project Proposal

Project Title: School-based Junior Secondary "STEM and trans-disciplinary subjects" education programme	**Project Number:** 2018/0996 (revised)

Name of School: Delia Memorial School (Glee Path)

Direct Beneficiaries

(a) Sector: ☐ Kindergarten ☐ Primary ☑ Secondary ☐ Special School *(Please put a tick in the appropriate box(es).)*

(b) Beneficiaries: (1) Students: 369 (S1-S3) ; (2) Teachers: 12 ; (3) Parents: 738;
(4) Others: not applicable

Project Period: 08/2020 to 07/2021 (For a year: for the S1 students admitted for 2020/2021 cohort; but it will be repeated for 3 years with different topics)

1. Project Needs

1.1	Project Aim(s)	The project aims at arousing students' interest in solving daily life challenges that may be helpful to our daily living. By applying knowledge to facilitate daily living, the school-based "STEM and trans-disciplinary curriculum" will be developed. Key learning areas (KLAs) including Language, Mathematics, Science, Technology, Art and School-based Generic Skills Education (research skills and other skills mentioned in Learning to Learn 2+) are involved in the curriculum. Students with the necessary knowledge, skill and attitude in different KLAs are equipped in the implementation process. In addition, students will work in groups with their schoolmates and teachers in STEM lesson, thus facilitating the application of knowledge and problem-solving skills from different subjects in the real-life situation. Teachers, on the other hand, will develop their professionalism in cross-curricular teaching through teachers' development programmes conducted by the coordinator of the "STEM and trans-disciplinary curriculum".
1.2	Innovative element(s)	The school-based "STEM and trans-disciplinary curriculum" will serve as an entry-point for creativity in various subjects. Students will be taught hands-on skills in various application and they can in turn transfer their knowledge in other subjects. With most notably benefits when working with Science, Mathematics, Language and School-based Generic Skills Education (Research and Enquiry) subjects, students will be able to carry out their own hypothesis with their acquired skills in completing an experiment. The main idea comes from a group of students, brainstorming for solutions in a well-equipped STEM Lab, solutions that are created by students instead of an imitation will be a major breakthrough for our students.
1.3	Alignment with school-based / students' needs	With new knowledge and technology looming in our everyday life, students should be well equipped with the skills required to handle new information. However, the existing curriculum does not allow students to utilize the knowledge for various subject curriculum in real-life situation. Thus, it is imminent with the integration of knowledge in STEM-related disciplines with language and generic skills education which enable students to get a hands-on experience through applying the knowledge, skills and attitude across all other subjects.

		In our existing practice, different KLAs have developed students' generic skills separately in their own corresponding curriculum. There is no systemic planning in a whole-school approach what kinds of generic skills should be developed and what the expected level of generic skills processed by our students in every secondary level. It is observed that students may repeatedly manipulate the generic skills in every subjects they have taken and the expectations of subject teachers are different that students cannot consistent develop the skills and it is highly likely that students may not know generic skills can be applied into different subjects.

2. <u>Project Feasibility</u>

2.1	Key concept (s) / rationale(s) of the project	The rationale of this project comes with the promotion of the STEM Education. Our school has been developing the school-based STEM education program for junior 1 to 3 students. In the coming years, the curriculum of Science Education, Technology Education, Mathematics Education, Language Education and School-based Generic Skills Education will be evaluated and revised. The common core knowledge and generic skills between the curricula are highlighted and further adjusted to respond to different educational needs of students. Integrated STEM instructional framework (The S-T-E-M Quartet) suggested by National Institute of Education (NIE), Singapore are adapted and further modified as "STEM and trans-disciplinary curriculum" that vertical knowledge within the aforementioned disciplines, including Language, Art and Generic Skills Education, is emphasized together with the horizontal connections between the aforementioned disciplines in order to solve the daily life examples. In the research of Drake & Reid (2010) and Ministry of Education, Ontario (2010), the Ontario curriculum documents (Social Studies, Mathematics, Language, Science and Technology and the Arts) have built on the foundation of integrated approach which related contents are linked that students have the opportunity to use concepts and skills from 2 or more subjects to meet the expectation of projects. It is suggested that students who have taught under the integrated curriculum demonstrated academic performance equal to, or better than students in discipline-based programs and they were more engaged in school and less prone to attendance and behavior problems. The school-based "STEM and trans-disciplinary curriculum" targets on the S1 students admitted in 2020-2021. Students will have normal lessons in Languages, Mathematics, Science, Technology, school-based Generic Skills and STEM lessons as stated in the S1 teaching scheme. "STEM and trans-disciplinary curriculum" coordinator will work with the subject panels of the KLA to highlight the core knowledge, skills and attitude which are required for students to answer to the real-life problems using Design Thinking approach. In Design Thinking, students are required to ticket the complex daily life problem in a more human centric way by adopting the 5-stage (Empathise, Define, Ideate, Prototype and Test) in the Design Thinking approach. In the last 2 months of the academic year, a project will be introduced to students that they need to answer to a daily-life problems with a prototype based on the knowledge, skills and attitude learnt in different KLAs. About 8 55-min STEM lessons will be provided to students for completing the project. Students will be assessed through the extent and supporting evidence of answering to the research questions in accordance to the rubrics and written assessment of core knowledge, skills and attitude of corresponding subjects. In S2-S3, students will be further consolidated what they have learnt in S1. For example, students in S2-S3 will learn more about hand-on engineering techniques like the use of circuit, cutting of wood, hot glue gun, etc in the STEM lessons. Students can further apply the Design Thinking process with

		the new knowledge skills learnt in different disciplines, such as Generic Skills to set questionnaires and interview to further investigate the needs of students to make a stationery box which satisfies the need of students; build a circuit which a light bulb when a memo is stuck on the stationery box through the application of Science and STEM knowledge they have learnt in S2. Moreover, in S3, they can further work on the project which builds a greenhouse in the school campus with a limited area. Through Design Thinking, students can use knowledge from Generic skills to set interview and questionnaires to investigate the restriction of the school campus; use the knowledge from Science (Photosynthesis), Maths (Volume and Cost calculation) and Technology (KLAs to build a suitable greenhouse with suitable materials, sensors and dimension to supervise and measure the growth of plants. Finally, they can write a report and present research findings with a suitable genre which is trained by the Language KLA. Through repeated practice of solving daily life problem, students are required to recall and apply knowledge from different disciplines.

2.2	Applicant's readiness or ability/ experience/ conditions/ facilities for project implementation	Our school-based STEM curriculum has been commencing since the beginning of the academic year 2018-2019. Students has had experience in designing simple figures using 3Ds Max and and they are capable of using the 3D printer. Students were asked to design, build and decorate a vehicle which runs on readily made motor which are controlled by . The vehicles act as a soccer robot which students need to kick the ball to the goal. Our school-based Generic Skills Education curriculum has also been commencing since the beginning of the academic year 2018-2019. Students are taught with the basic research skills like searching 1st hand and 2nd hand data and presentation of the data collected. The curricula of Language, Science and Mathematics have been implemented for several years and the effectiveness of students' learning is being reviewed through effect size analysis and observation of lesson and homework. Moreover, students have plenty of experience in using programming tools to create their programs in the vehicle using Students in the junior form has been asked to create animations using . The students have had a chance to experience the process of planning, implementing, testing and improving their program throughout the school year. For students with higher capability, they have been dealing with a project that required them to utilize database design and implementation. Students are comfortable in saving and retrieving data within , thus, it will provide more flexibility in program designing. As for App Inventor, students learned to create an App with the requirement of providing assistance to our everyday life. Students were able to implement their App and distribute their App to other people. With an ample opportunity for trial and error, students were able to vision the needs of our daily living and create Apps that will solve our problem.
2.3	Principal's and teachers' involvement and their roles	A "STEM and trans-disciplinary curriculum" committee which comprises the principal, panel chairpersons of the concerned KLAs and teachers has been set up to coordinate and monitor all teaching and learning related matters including this project. "STEM and trans-disciplinary curriculum" coordinator will be responsible for highlighting the core knowledge, skill and attitude required for the completion of project from each KLA and ensuring the teaching quality of teachers in the corresponding KLAs and "STEM and trans-disciplinary curriculum" Teachers involved in teaching STEM and the I.T. department will participate in teacher's development programmes of the subjects, which includes the , 3D printer and laser cutter training. Teachers with the KLA concerned will be involved in establishing the development of the "STEM and trans-disciplinary curriculum" while the STEM and I.T. team will be involved in preparing all the necessary hardware and software involved in the project. In addition, students' product will be showcased in exhibitions in order to share the learning outcomes from the students.
2.4	Parents' involvement / participation (if applicable)	As part of the STEM curriculum, parents' involvement is essential to the success of the skills learned in the course. Parents can reinforce students regarding the skills acquired during their lessons. For instance, students learn to write programs assisting our daily life, he / she can share their implementation process and the product with their parents. Students can gain insight in the sharing process and receive valuable feedback from parents, the feedback may encourage students to further improve their product and add creative ideas into their own invention. The STEM product creation can create an environment that would allow parents and their child to maintain communication, parents will get a chance to envision the newest technology created by their child. With the funding provided, students of the lower class family will get a fair share of opportunity to learn and explore the newest technology, students can

		acquire the skills at school while parents will also get a chance to explore the new gadgets at home. Since STEM requires building skills from various job nature, the involvement from parents will definitely be beneficial to their child.
2.5	Roles of collaborator(s) (if applicable)	N/A

2.6 Implementation timeline

Implementation period *(MM/YYYY)*	Project activities
08/2020	• Procurement of notebook, and laser cutter. • Discussion of the rationale and the corresponding curricula under thematic approach with panel heads in Science, Technology, Languages, Mathematics and Generic Skills Education to ensure the core knowledge learnt can be applied to the theme of the project • Conduct teacher training workshop (around 6 hours) to teach teachers necessary skills to manipulate , 3D printing and instructing students using Design Thinking approach required in the school-base curriculum under thematic approach • Teachers' meeting with panel heads and members Science, Technology, Mathematics, Language and Generic Skills education to ensure all relevant teaching staff understand and are involved in developing the teaching & learning materials and assessment of students' performance
09/2020	• Review the lesson plans and conduct pre-lesson meeting
09/2020 – 04/2021	• Meeting with the panel heads in Science, Technology, Languages, Mathematics and Generic Skills Education to monitor the implementation of the curriculum.
04/2021 – 06/2021	• Implementation of project in "STEM and trans-disciplinary curriculum"
06/2021– 07/2021	• All the teachers related to the project discuss on the students' performance in the project • Showcase students' work and all learning and teaching materials to all staff and interested schools

2.7 Details of project activities *(Item (a)-(f) not applicable to this application can be deleted.)*

a. Student activity, if applicable

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	No of sessions and duration	Teachers' involvement and/or hired personnel *(Including the roles, qualifications and experiences required of the speaker(s)/ instructor(s), etc.)*	Expected learning outcomes
	The following activities are arranged for students in S1 in the school based STEM lesson. S1: Use of to code a program to evaluate the living conditions of a district	4 sessions, 55 mins for each lesson	To be taught by school teachers with relevant knowledge and experience; "STEM and trans-disciplinary curriculum" coordinator will coordinate with STEM related teachers to monitor and advise their work.	Students are expected to set a simple program using different sensors coded in and collect data through ThingSpeak and present relevant data with suitable graphs and IT software. STEM and Technology: Understand the concepts of computer instruction and programming through
3D design and printing; Laser cutter	The following activities are arranged in the school based STEM lesson for students to apply knowledge across KLA. S1: Use of Tinkercad to create a protective coat for and sensors; more capable students can use Adobe AI to further adjust and print the protective coat by the laser cutter	3 sessions, 55 mins for each session	To be taught by school teachers with relevant knowledge and experience; "STEM and trans-disciplinary curriculum" coordinator will coordinate with STEM related teachers to monitor and advise their work.	Students are expected to use Tinkercad to design basic products with knowledge from the Computer Literacy and Maths lesson to make a character with a designated volume and shape. More capable students can design and print the products by laser cutter. STEM and Technology: Use of Tinkercad and/or Adobe AI to design designated product Mathematics: Use designated shape and volume to make the protective coat; Calculate the cost of making the characters and errors in measurement of 3D printer in making the product.
Integrated project	The following activities are arranged in the school based STEM lesson for students to apply knowledge from different disciplines	8 sessions, 55 mins for each session	To be taught by school teachers with relevant knowledge and experience; "STEM and trans-disciplinary curriculum" coordinator will coordinate with STEM related teachers to monitor and advise their work. Subject teachers in different KLAs design the	Students are expected to use conduct a research project; gather relevant information; prototype and evaluate the suggested solution. Science: observation; identify and define problems; and analyzing data scientifically.

			relevant guided questions and worksheet to facilitate students' research.	Technology: Use of Internet, Word processing and Spreadsheet Mathematics: Use of mathematics, especially statistics, in making informed decisions in life STEM: The use of Design Thinking to prototype to solve problem in a human centric way Generic skill: Data collecting skills

b. Teacher training, if applicable

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	No of sessions and duration	Teachers' involvement and/or hired personnel *(Including the roles, qualifications and experiences required of the speaker(s)/ instructor(s), etc.)*	Expected learning outcomes
Teacher training workshop (2 days)	Teacher training workshop for will be organized	3 hours session; for two sessions on separate days	• The panel chairs and all teachers teaching STEM • All related personnel from the I.T. department • Trainers recruited from the corresponding company	Teachers can handle (both the robot, sensors and the software), be comfortable in using it and teach students in designing with various purposes according to the task(s)
3D printer, and laser cutter training workshop (5 days)	Teacher training workshop for 3D printer and laser cutter will be organized	4 hours session; for five sessions on separate days	• The panel chairs and all teachers teaching STEM • All related personnel from the I.T. department • Trainers recruited from the corresponding company	Teachers can handle the software and the hardware to complete the assigned task and teach students in designing with various purposes according to the task(s)
Design Thinking Training	Teacher training workshop for the rationale and instruction approach of Design Thinking	3 hours session	• All teachers in the school, especially S1 subject teachers • Trainers is the teachers in our school who attend courses about instructing students in Design Thinking approach in "Volunteers in Asia" in San Francisco and "NIE" in Singapore.	Teachers can instruct design in conducting a research and design products in a human centric way through the 5 steps in Design Thinking. We will use a real life problem encountered in the school as an example of the problem to be solved. For example, the setting of library/ STEM room may not be convenient for teachers and students to use the

				facilities. We can identify and define the diverse needs of different parties and adjust the operation of the library in a more human centric way to suit our needs.

c. Equipment (including installation of new fixtures or facilities), if applicable

	Details of equipment to be procured	Contribution to fulfilment of the project aim(s) and if applicable, the expected utilization rate
1	Notebook x 41	For learning and preparation of projects students
2	3D printers x 2 and laser cutter x 1	For facilitation of and sensors using outside the classroom
3	with sensors x 20	For learning and detecting the physical environment of Mei Foo and the school

d. Construction works, if applicable

e. Features of the school-based curriculum to be developed, if applicable

Integrated STEM education in the aforementioned disciplines is effective when students are provided with a series of open-ended, hands-on activities related to a thematic topic that addresses important concepts related to STEM disciplines. It incorporates a process of inquiry-based activities which encourages students to contextualize the project with respect to their existing knowledge and experience through explanations by teachers and self-study, followed by the opportunities to model and practice solutions with constructive feedback received by peers and teachers. This type of self-directed learning allows students to have more authority in learning, enhancing motivation and metacognitive skills in learning.

The majority of our students are Non-Chinese speaking students with different cultural backgrounds. Most of them are relatively weak in STEM education, value and attitude as Hong Kong citizens and generic skills, especially communication, mathematical and IT skills, requested in Learning to Learn 2+ – Hong Kong School curriculum. In order to equip them with the aforementioned knowledge, skill and attitude, a curriculum development committee is set and teachers from Language, Mathematics, Science, Arts and School-based Generic Skills Education subjects are proposed to implement the school-based project under the same theme – "Self and Glee Path" for S1 students in the academic year 20-21. They need to manipulate their knowledge to collect data on the demographic information, facilities and physical environments of our district and our school- Glee Path and comment on whether Glee Path and the district nearby is an ideal environment for the students to study here.

Students are requested to apply the core subject knowledge learnt in both central curricula and school-based curricula. For example, students are requested to set a research question and collect data through questionnaire, interviews and search relevant and reliable 2nd hand data on the Internet which is learned in the school-based Generic Skills Education subject; Students will also use of different sensors, such as PM 2.5, light and temperature sensors to record the physical environment of the school campus through the knowledge acquired in the school-based STEM subject. Moreover, in mathematics, IT and science subjects, students acquired the necessary knowledge to present and analyze data with suitable graphs through IoT and Excel to interpret whether Glee Path provides a suitable atmosphere for our students to study. Finally, students are requested to report their findings and present to our citizens using suitable genres learnt in language subjects. All S1 students are divided into different groups and each group are supervised by a subject teacher to provide immediate feedback for their learning. For more capable students, they can prototype the solutions through creating models laser cutter and 3D printer which is learned in the STEM lesson.

In order to learn in the "classroom without boundary", a portable notebook and equipments for STEM subjects are necessary for our students. A portable notebook allows students to connect with and sensors to collect and process data; collaboration between group members in the Apple-instruments equipped classrooms (all the classrooms in our school are equipped with high speed Wifi and Apple TV). They could connect to sensors through and process the data immediately in notebook.

Students are evaluated by both summative and formative assessments. In the written unified test and exam, questions about the knowledge and skills used in the projects are assessed; rubrics of the project work are distributed and evaluated by peers and teachers with constructive feedback. Students are assessed by their performance in different parts of the project.

The core elements of Technology education are well covered in the Computer Literacy lessons as students learn how to control , 3D printer and laser cutter in the STEM lesson. In S1, students learn about the use of in S1 and further focus on , video editing and App Inventor to ensure students develop logical thinking skills, problem solving skills and computer programming skills through .

f. Other activities, if applicable (Please specify how they contribute to fulfilment of the project aim(s).)

N/A

2.8 Budget

Total Grant Sought: HK$ 318,000

Budget Categories*	**Breakdown for the budget items**		**Justifications** *(Please provide justification for each budget item, including the qualifications and experiences required of the hired personnel.)*
	Item	**Amount (HK$)**	
a. Equipment	1. Notebook x 41 (HK$5,000 x 41)	HK$205,000	For teaching and learning activities; 41 students in a class
	2. 3D printers x2	HK$8,000	For teaching and learning activities in STEM lesson for making protective parts for and sensors
	3. Laser cutter x1	HK$60,000	For teaching and learning activities in STEM lesson for making protective parts for and sensors
	4. with sensors x20 (HK$2000 x 20)	HK$40,000	For teaching and learning activities in STEM lesson for measuring different abiotic factors in a district
b. Audit	1. Audit fee	HK$5,000	Required by QEF EPM
	Total Grant Sought (HK$):	**HK$** 318,000	

* (i) Applicants should refer to the QEF Pricing Standards in completing the above table. All staff recruitment and procurement of goods and services should be carried out on an open, fair and competitive basis. Budget categories not applicable to this application can be deleted.

(ii) For applications involving school improvement works, a contingency provision of not more than 10% for carrying out works is considered acceptable.

(iii) For projects lasting for more than one year, a contingency provision of not more than 3% of the total budget exclusive of staff cost and works expenditure (including the related contingency provision), if any, is considered acceptable

3. Expected Project Outcomes

3.1	Deliverables / outcomes	☑ Learning and teaching materials ☑ Resource package e-deliverables**(please specify)* _____ ☑ Others *(please specify)* _____ The followings will be prepared after the completion of the project 1. Resources package (learning and teaching materials) for our teachers in all KLAs which are related to the project. 2. 3D printer, notebooks and laser cutter can be used by all students after school under teachers or technicians' supervision. 3. Students' samples of work in all related KLAs. 4. Able to participate in the competitions related to the use of and 3D design * *For e-deliverables to be hosted on HKEdCity, please liaise with HKEdCity at 2624 1000.*
3.2	Positive impact on quality education/ the school's development	The acquisition of equipment allows the implementation of trans-disciplinary project for S1 students which nurture them to apply knowledge, skill and attitude across KLAs in the real-life situation. The learning and teaching materials used can be shared among colleagues and schools.

3.3 Evaluation

Please state the methodologies of evaluating project effectiveness and provide the success criteria.

(Examples: lesson observation, questionnaire survey, focus group interview, pre-test/post-test)

1. The research project will be evaluated through observation, questionnaire surveys, group interviews and students' performance in STEM-related subjects. The evaluation items are listed below.
2. The effectives of the school-based STEM education programme for junior secondary students. (success criteria: 80% of the teachers and students agree that the project helps to promote the effectiveness of learning of knowledge in different disciplinaries involved in "STEM and trans-disciplinary curriculum" education)
   To arouse students' motivation in learning. (success criteria: 80% of students agree that the research project help to promote motivation in learning which is assessed by the Motivated Strategies for Learning Questionnaire (MSLQ) designed by Pintrich, 1991)
3. To enhance teachers' professional capacity (success criteria: 80% of teachers agree that the project help to raise their confidence in implementing collaborative teaching and "STEM and trans-disciplinary curriculum")

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For applications with grant sought <u>exceeding $200,000</u>, please complete Parts 3.4 and 3.5.

3.4 Sustainability of the project

- By the end of the project, an evaluation meeting will be held for the committee members and the teachers involved. They will discuss how to further develop the school-based STEM education and design learning and teaching activities of different themes. The materials will be shared to for the access of other teachers.
- The maintenance fee and the purchase of new equipment of the project in future will be borne by the school. The school will continue to make good use of the facilities and equipment to conduct learning and teaching activities in order to enrich students' learning experience after the completion of the project.

3.5 Dissemination

Please provide a dissemination plan for sharing the good value of the project with the school sector.

(Examples: dissemination seminar, learning circle)

- The school plans to organise a sharing seminar for the teachers of the district by the end of the project period so as to showcase students' learning outcomes, share the project experience and tips for implementing STEM learning activities. The seminar includes different STEM expo in Hong Kong
- The deliverables will be uploaded to the school webpage for teachers' reference.

3.6 The Asset usage plan

Category (in alphabetical order)	**Item / Description**	**No. of Units**	**Total Cost**	**Proposed Plan for Deployment** *(Note)*
audio and video equipment				
book & VCD				
computer hardware	1. Notebooks 2. with sensors 3. 3D printer 4. Laser cutter	1. 41 2. 20 3. 2 4. 1		To be used by the STEM and the IT departments of the school as equippments for lessons and extra-curricular activities for the continuity of the project
computer software				
musical instrument				
office equipment				
office furniture				
sports equipment				
Others				

3.7 Report schedule

My school commits to submit proper reports in strict accordance with the following schedule:

Project Management		**Financial Management**	
Type of Report and covering period	**Report due day**	**Type of Report and covering period**	**Report due day**
Progress Report 01/08/2020 - 31/01/2021	28/02/2021	Interim Financial Report 01/08/2020 - 31/01/2021	28/02/2021
Final Report 01/08/2020 - 31/07/2021	31/10/2021	Final Financial Report 01/02/2021 - 31/07/2021	31/10/2021

4 Reference

Drake, S. M., & Reid, J. (2010). Integrated curriculum: Increasing relevance while maintaining accountability. What works, 28(1).

Ministry of Education, Ontario. (2010). Integrated learning in the classroom. Capacity Building Series.

Pintrich, P. R. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).