Quality Education Fund

The Dedicated Funding Programme for Publicly-funded Schools

Part B: Project Proposal

Project Title:	**Project Number:**
From Runway to Pathway: Establishing a School-based STEM Aerospace Learning Programme and Exemplary Laboratory	2018/0618*(Revised)*

Name of School: _ _

Direct Beneficiaries
(a) Sector: ☐ Kindergarten ☐ Primary ☑ Secondary ☐ Special School

(b) Beneficiaries: (1) Students: 750 (S1-S6); (2) Teachers: 15; (3) Parents: not applicable;

Project Period: 10/2019 to 9/2021

1. Project Needs

1.1	Project Aim(s)	This project aims at developing a school-based STEM Aerospace programme with the use of emerging technologies. The program does not only arouse students' subject and career interest, but also consolidates their interdisciplinary knowledge in STEM-related subjects through inquiry-based learning. Participants will also benefit from the design and implementation of the STEM learning programs.
1.2	Innovative element(s)	The project consists of school-based innovative element. Our school has organized flight training workshops and pull-out gifted programmes on learning STEM through Aerospace since 2017. In the programs, our vision is to successfully implement curricula that enrich multidisciplinary teaching and learning with the use of physical facilities. As such, in this academic year, Aerospace Elite Team was established so as to bring STEM education to new heights through designing experiments and holding flight simulation workshops. Students were actively engaged to apply interdisciplinary knowledge such as physics, mathematics, geography and language to solve aeronautical problems. Through these aerospace and flight training programmes, teachers can maximize students' learning opportunities, help them develop their potential and promote their learning output aligned with the school's three-year development plan. **Objectives** - To arouse students' interest in aerospace learning; - To enhance students' understanding on aerospace sciences with higher order thinking skills through deeper learning in the physical facilities; - To make use of flight simulators, 3D printing and other emergent technologies for learning to enable interactive learning; - To conduct evaluation to understand students' learning experiences in aerospace education; - To promote e-learning pedagogical practices to other secondary schools by sharing learning materials, and conduct demonstrations for experience sharing. **Emphasis of "Cross-subjects" STEM Curriculum through Aerospace** Aerospace as a theme can fill the gap to learn STEM and the incorporation of simulation technologies can effectively enrich their subjects. Aerospace learning can potentially enhance key aspects and enrich the "cross-subjects" curriculum guides in Hong Kong. Students can use flight simulation software as a fascinating tool to learn about science principles, like acceleration, , conservation of energy and momentum, motion and forces. Our programme can also allow students to use

engineering methods to design, test and then implement their designs to obtain the best score.

Aerospace education was defined as "a branch of general education concerned with communicating knowledge, skills, and attitudes about aviation" to implement STEM education and its multi-disciplinary subject knowledge to understand and appreciate the potential of aviation and space at that time". At present, some countries have already initiated the aerospace STEM curriculum.

, the world's largest aviation community, has established an aviation STEM curriculum for high schools across America. This organization organizes a symposium on a yearly basis to provide a platform for educators to share good practices and ideas to infuse aerospace into STEM classrooms. There is a strong potential in the program to develop their career path into aviation industry. Also, other organizations like Fly to Learn offer activities to promote STEM learning by designing, building and flying virtual airplanes in the US, providing learning activities for 125,000 students and 9 million users use plane simulator to learn flying. In the future, the Aviation and Aerospace STEM activities can arouse the students' interest in learning "cross-subjects" knowledge and discovering more about the aviation industry as a career. With reference to the good practices of aviation teaching and learning, we will introduce an aerospace education curriculum to engage our students to get insights into different cross-subject elements (refer to Appendix for details):

- Air Traffic Control & Radio Communication (Languages)
- Aviation History (Social Science)
- Airmanship (Science and Mathematics)
- Principle of Flight (Science and Mathematics)
- Aviation Engineering (Engineering)

Paradigm Shift in Technology Learning: Using Flight Simulation to Foster Students' Self-directed Learning

Inquiry-based Learning has been adopted to facilitate students in learning how ideas can be transformed into formalized understanding and further questioning (Zion & Mendelovici, 2012). Raising students' curiosity towards open-ended investigations into a question or a problem is a key element to engage in evidence-based reasoning and creative problem-solving, as well as problem finding.

In our aerospace program, it provides a platform for both teachers and students to share the collective and cognitive idea to enrich the knowledge (Scardamalia, 2002). Such "collective cognitive responsibility" has cultivated our students a passion for deeper learning inside and beyond the classroom. In this regard, students are encouraged to become self-directed learners to read books and raise questions extended from the existing curriculum based on their curiosity and passion.

Under this engagement framework, aerospace learning program is a stimulus for students to engage in STEM activities through technology-based learning (Murdock, 2017). Teachers raise questions to incorporate a variety of knowledge such as algebra, geometry, physics, earth sciences and engineering. Students apply their subject knowledge and integrate emergent technologies in STEM learning.

In our program, students will be engaged in activities to integrate flight simulators to raise aeronautical questions regarding the design and engineering of aviation. The questions are tabulated below:

Physics and Applied Engineering: Instead of pointing the nose down to the runway, why do planes point slightly upwards to the sky when landing? Students then design a model to show the pressure difference between upper and lower sides of aero foil by principle and with flight simulation, 3D printing and laser cutting technology.

Algebra and Flight Planning: You have 50 gallons of fuel on board, and only 48 of that is possible. Suppose 8.5 gallons/hour of fuels are burnt, will the pilot make his destination with a half hour reserve of fuel? Student then use flight simulators to

		estimate the fuel needed to reach the destination. Three-dimensional Geometry and Instrumental Control: Given that we intercept a certain degree radial from a navigational aid, what does the intercept heading need to adjust if the radial is now at an angle of 30 degrees? Student then use flight simulator to adjust the heading of plane with space sense. **Construction of a Platform for Collection of Good Examples of STEM L&T** Our online resources including recording videos and teaching materials will be shared with other schools and organizations which are interested in developing aerospace programmes. Once the materials are available on a public platform, teachers from other schools can access the online platform effectively and the platform is well-constructed for posting feedback. The teaching materials will be efficiently delivered and shared and this will eventually save teachers' time on material preparation. Upon the availability on the provision of the portable devices and laptops, students from different social economic status can manipulate such technology beyond classroom. Teaching pedagogies such as flipped classrooms and online open courses can be an inexpensive way to narrow the socio-economical gap by providing an inexpensive and cost-effective learning solution. The cost will be further reduced when teachers are sharing teaching resources as in massive online open courses (MOOCs), kind of platforms, in which we and the participating schools contributed the works freely to other users. A well-structured curriculum and tailor made teaching materials are suitable for the future need. An effective manipulation of an innovative learning technology must be accompanied by quality learning contents. A particular merit is placed on our proposal because of the collaborative work from different professional to construct the curriculum. **Pathways to the Runway: Nurturing Flying Professionals through School-based Programme** Airlines across the globe are expanding their fleets and flight schedules to satisfy future demand. Our school-based programme is to promote academic interest in science and aviation. We hope to nurture enthusiasts in the aviation industry by providing a foundation of aviation skills and knowledge and bring up our students to become future leaders in the industry. The programme will provide our students with aerospace bridging courses and career guidance between secondary education and beginning a study in tertiary learning or future career in the aviation industry. Our programme will provide a balanced and structured STEM learning activities focused on potential students in their pursuit of an aviation career. In the activities, our teachers will inspire students by exploring different areas of aviation in the virtual facilities powered by flight simulation and immersive virtual environments to promote aviation interests and the pursuit of aviation knowledge. A bridging course for filling in the knowledge gap between secondary school and tertiary education will be offered. Lifelong learning and career guidance is essential for the students to make a wise choice on their future career. Volunteer instructors and guest speakers will be invited from local organizations such as to promote professions within the aviation industry. After graduation, students could choose to become a scientist or engineer to pursue their studies in aviation studies such as
1.3	Alignment with school-based / students' needs	One of the focuses of the school's three-year development plan (2016-2019) is to maximize students' learning opportunities, help them develop their potential and promote their learning output. STEM learning through Aerospace program can enrich students' multi-disciplinary knowledge through inquiry-based activities to arouse their academic and career interests and provide learning opportunities that could align with the developmental needs of students and apply what they have learnt.

2. Project Feasibility

2.1	Key concept (s) / rationale(s) of the project	The rationale of this project comes from the suggestions stated in the "Report on Promotion of STEM Education - Unleashing Potential in Innovation" (December 2016) released by the Education Bureau. The main points include: - Renewing the curricula of the Science, Technology and Mathematics Education Key Learning Areas (KLAs) - Enriching learning activities for students - Enhancing professional development for schools and teachers **Aerospace-themed Curriculum Enrichment and Career Development** We target to enrich our existing school-based curriculum of junior secondary Mathematics, Science and Technology Education. Learning activities including flight simulating, 3D printing, robotics and virtual field tour will be organized for students from different forms. S1 to S4 students have to apply the knowledge in tackling the tasks in our programs. Our program offers opportunities for senior form students to expose to aviation industry. The career development can be promoted in accordance with the interests developed from the program. **Promotion of Higher-order Thinking Skills Using Inquiry-based Learning** Teachers will adopt the inquiry-based learning to facilitate students in learning how ideas can be transformed through understanding and further questioning. Through aviation/ aerospace, we can arouse students' curiosity towards open-ended investigations into questions which require them to engage in evidence-based learning and creative problem-solving and finding. For example, students can observe classmates' virtual flying practice and test their predictions by experiment and study. They spend hours researching and practicing into the subjects and we will incorporate small learning tasks with increasing degree of difficulty and, after all, we plant the seeds of science and technology through subject disciplines. **The 3-tier Curriculum Design, Implementation and Dissemination** During the project developmental stage, we will ***establish the STEM aerospace-themed curriculum and open learning resources for 3 tiers***. STEM-related subject teachers and 400 students are engaged in the first tier in our school, and 200 students of our affiliated primary school and the other 500 students in our school in the second tier; and invite parents and students from neighbouring schools to learn STEM through aerospace in the third tier. All primary 6 students from our affiliated school, , are welcome to visit our school for experiencing the flight simulation activities, and the primary 5 students will have chance to engage in the learning activities related to the principle of flight. Students from the affiliated primary school would be nominated based on their interests and capabilities to attend the workshops on Spacecraft design. A series of teacher trainings and student activities with flight and space simulation will be hosted throughout the 2.5-year period. Upon the end of the project, three teaching packages of a curriculum guide, lesson plans, worksheets and coursewares will be refined, published and distributed in the platform to all students and teachers. Our focus of service will be concentrating on the primary and secondary school teachers, as well as teachers and students from tertiary institutes and the public indirectly.
2.2	Applicant's readiness or ability/ experience/ conditions/ facilities for project implementation	• As we observed that our students were highly curious about and interested in science-related topics and need more challenging tasks in science, a pull-out gifted program named "Aerospace Elite Team" was established. • Using the flight simulator program, Aerospace Elite Team was just an extra-curricular activity to introduce our students to the exciting and challenging task of piloting an airplane. It is not as easy as it looks in movies or video games. A vast amount of knowledge is required just to keep an aircraft at a stable altitude, let alone go in desired directions. • Now, it becomes a school-based pull-out program for our gifted students and its curriculum and activities are designed and implemented based on the Purdue

		Three-stage model. The Purdue Three-Stage approach to gifted education is an enrichment model to provide engaging instruction for talented learners (Feldhusen & Kolloff, 1988). The model provides an effective framework for differentiated instruction for gifted and talented students to deliver advanced content and provide for the development of higher order thinking skills. • Since 2017/18, our school has been organizing pull-out aerospace learning programme. We possess rich experience in organizing relevant learning activities. • We had engaged 300+ students in STEM workshops to promote aviation/ aerospace learning • We were then invited to demonstrate in a STEM Thematic Talk and School Visit • In order to further implement STEM learning, we plan to incorporate STEM into secondary curriculum and career planning, and establish an "Aerospace Laboratory" so as to enrich students' learning experience in the different key learning areas and enhance teachers' professional development with teaching resources.
2.3	Principal's and teachers' involvement and their roles	An administrative committee, which comprises the principal, curriculum coordinator, panel chairpersons of STEM-related subjects and career team, will be set up to coordinate and monitor the project within the project period. • Principal: The principal will, in collaboration with teachers, plan activities and monitor the progress of the project. • Teachers: - Panel heads of each subject will discuss and prepare the training materials and the revisions to the school-based curriculum. - Teachers from aerospace elite team will participate in teachers' development programmes. They will be involved in enriching the existing school-based, developing and trying out the newly developed STEM learning activities. - Teachers will conduct lesson-study and cross-subject collaborative meetings. Moreover, dissemination activities will be organized to showcase students' learning outcomes.
2.4	Parents' involvement / participation (if applicable)	N/A
2.5	Roles of collaborator(s) (if applicable)	To deliver the aerospace learning and teaching more effectively, the school has also participated in the School-based Support Programme on developing an aerospace education programme a uniformed youth organisation providing aviation education, non-formal education and leadership training to local young people.

2.6 Implementation timeline

Implementation period *(MM/YYYY)*	Project activities
10/2019 – 1/2020	**Preparation** - Invite quotations for renovation of the aerospace laboratory and procurement of relevant equipment and materials. - Hire a project assistant.
1/2020 – 2/2020	**Design** - Review and enrich existing STEM-related learning content and develop school-based STEM Aerospace learning programme for junior and senior secondary students. - Conduct meetings to design the curriculum which covers the areas of Principle of Flight, Airmanship, Aviation History, Basic Radio Communication in Air Traffic Controlling and Aerospace Exploration, etc. - Develop technological facilities and purchase related equipment.
3/2020 – 6/2020	**Flight Simulation and Aircraft Engineering** - Design and implement learning and teaching activities through flight simulation, aircraft engineering and sharing talks. - Pilot the learning activities such as 3D design of aircraft aerofoil, space and flight simulation, and conduct pre-lesson meetings based on the try-out programme in aerospace elite team.
7/2020 – 3/2021	**Space Exploration** - Conduct the learning activities for all junior secondary classes with the facilities and equipment which include space simulation, virtual reality devices and 3D printing. - Through lesson study, teachers can evaluate the key factors leading to the effectiveness of the project and determine successful factors to develop a school-based STEM programme and learning activities in the future.
4/2021	**Evaluation** - The administrative committee and teachers involved will evaluate the effectiveness of the project, and hence refine the developed curriculum, STEM pedagogy and career planning activities.
9/2021	**Dissemination** - Organise workshops and carnival within school to showcase students' learning outcomes. - Organise webinars to share project experience and project outcomes with the secondary teachers through online sharing platforms.

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

a. Student activities

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	Number 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
Flight simulation	To arrange the following learning activities with the learning elements of STEM-related subjects for S1 to S5 students : S1: Flight Simulation S2: Principle of Flight S3-6: Advanced principle of flight For S1 Flight simulation, the direction and calculation of linear speed will be incorporated in the Mathematics curriculum. For S2 Principle of Flight, the acceleration and the ideas of net force will be taught in the Integrated Science curriculum. The ideas of acceleration and circular motion for introducing the advanced principle of flight will be included in senior Science, especially the Physics curriculum. The content includes learning sciences and technologies through flight and space simulation activities. Other interested topics including air traffic control, airmanship and meteorology will be involved. Prediction-Observation-Explanation will be the learning strategy for understanding the principles of flight and its simulation. Experimental study on the design of flight will be conducted.	6 sessions, 1 hour for each session. Some of the tasks will be completed after lessons.	To be taught by school teachers with relevant knowledge and experience	Students can understand the basic principle of flight and conduct scientific investigations to complete the learning tasks.
Aircraft engineering	To arrange enrichment workshops as extra-curricular activities (for junior school students mainly): S1: 3D design and laser cutting S2: 3D design and printing S3-5: Advanced principle of flight The Aerospace Elite Team is an extra-curricular activity (ECA) to offer programsfor S1 to S5 students to use Information Technology skills with the laser cutting and 3D printer to manufacture the component parts (e.g. wing) of the plane. An extended Science	6 sessions, 1 hour for each session. Some of the tasks will be completed after lessons	To be taught by school teachers with relevant knowledge and experience.	Students can apply their science and D&T knowledge and skills to complete the learning tasks in the workshops. Their collaboration skills and problem-solving skills will be enhanced.

	curriculum will be offered in the ECA for teaching fluid dynamic model. Based on the technologies and scientific knowledge, students are expected to produce some engineered products. The content includes understanding how to use computer-aided design (CAD) software to assist 2D and 3D aerofoil design. Students will design and build up scientific models to investigate scientific theories. An inductive approach learning strategy will be employed. Students will collect a substantial amount of data to look at the pattern for 3D design and deduce the principle of flight.			
Space exploration	To arrange the following activities with the learning elements of STEM-related subjects for S1 to S3 students: S1: Spacecraft design S2-3: Space exploration S4-6: Space Science For S1, students are required to understand the ideas of density of different materials in Integrated Science for the spacecraft design. Calculation involved for density will be introduced in Mathematics lessons. For S2-3, understanding the engineering design on the shape of spacecraft to reduce friction, ideas of weightlessness and use of fuel as energy source will be introduced in the Integrated Science and Chemistry curriculum. S4-S6, gravitation and locus will be introduced in Senior Physics and Mathematics lesson for spacecraft travel. The energy produced from the spacecraft can be simulated using the ideas of enthalpy change in Senior Chemistry lessons. The content includes learning sciences and IT through VR space simulation in ECA. These activities can allow students to apply their knowledge in science topics related to Astronomy and Space Science. A deductive approach learning strategy will be employed to deliver the basic understanding on space science and astronomy. Students have to apply the theories for tackling the problems in space science and astronomy.	6 sessions, 1 hour for each session. Some of the tasks will be completed after lessons	To be taught by school teachers with relevant knowledge and experience.	Students can understand about the basic knowledge of space science and conduct simple scientific investigations to complete the learning tasks.

Career planning sessions	S1 to S6 students will participate in career planning and interested groups will further complete extended learning activities with professionals from aviation industry such as flight simulation workshop, job sharing session, site visits and professional forums.	The tasks will be completed after lessons.	To be coordinated by school teachers and some professionals will be invited to hold some flight simulation workshops and advise on their career.	Students can plan and realize the career prospects of aviation and aerospace.
Air cadets programme	We are making plan to partner to organize an extended Air Cadet Programme for participants in our school. They will join the activities in the training base of a squadron in Kwun Tong. The programme aims at widening students' horizon to civil aviation in Hong Kong and providing real practices in the aviation field. After training, participants will share their experience to our students to showcase their learning outcomes. We will also invite volunteer instructors and guest speakers from local organizations to introduce career path within the aviation industry. The selection criteria of the participants align with the requirements of . The participants should be secondary school students aged between 11 to 20 with proficiency in both Cantonese and English. They should have strong desire in learning more about aviation as well as participating in aviation activities, outing and physical training. The students in school will join the programme on a voluntary basis.	The tasks will be completed on Saturdays.	To be arranged the cooperation between and our school.	Students can get extensive exposures to Their career interest and motivation will be enhanced.
STEM sharing session	This sharing session will include students' sharing and booth displays which aim at summarizing the project activities so as to consolidate students' learning experiences and showcase their learning outcomes. We will also invite students from neighbouring schools, parents and teachers to learn STEM through aviation/ aerospace.	Several half-day events.	STEM-related subject teachers	Students can obtain extensive exposure to Their extensive experience, collaboration skills and problem-solving skills will be enhanced through the learning activities.

b. Teacher training

Activity name	Content *(Including the topics, implementation strategies/modes, target beneficiaries, selection criteria, etc.)*	Number of sessions and duration	Hired personnel *(Including the roles, qualifications and experiences required of the speaker(s)/ instructor(s), etc.)*	Expected learning outcomes
Teacher training workshops (16 hours)	Teacher training workshops will be organized for teachers of STEM-related subjects. The content includes: 1. Curriculum planning of STEM learning 2. Design and implementation of STEM-related learning activities 3. Workshops of flight simulator, 3D design and printing, Virtual Reality, laser cutting and D&T.	8 sessions, 2 hours for each session	Qualified trainer(s) will offer workshops of flight simulator, 3D design and printing, Virtual Reality, laser cutting and D&T. Teachers from different disciplines including information technology, science and mathematics will design and implement the curriculum, as well as provide teachers with sufficient training.	Teachers can understand and collaboratively plan the STEM activities. They can acquire skills and knowledge of aerospace and aviation field as well as using the related technologies.
Online materials development (6 hours)	Teaching videos will be taken and shared among themselves. The content includes: 1. Principal of flights 2. Demonstrations of flight and space simulation.	6 sessions, 1 hour for each session.	A project assistant will assist teachers in developing teaching resources and preparing materials for aerospace learning activities. Therefore, the assistant should be university graduate and have IT knowledge of web construction.	Teachers can make good use of learning management platforms and create videos for students to learn in a self-paced mode.

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	Six high performance computers	The high-performance computers will be used for conducting the aerospace activities and providing curriculum guide and teaching materials to facilitate future teaching for students and teachers. They are needed to support the virtual reality and graphics interface of the simulation software. High performance with VR-ready laptops are used to prepare mass number of videos and multimedia teaching materials in the constructed platform and support VR learning. Recommended specification for laptops

		The computer must fulfill the system requirements of the selected flight simulation software and VR softwares.
2	Six flight simulation software licenses with plugins	The flight simulation software and plugins The recommended system requirements is strongly recommended, graphic card video memory 8GB. In the flight simulation workshops, students will learn topics related to science and technologies through experiencing virtual flying.
3	Six flight rudder pedals	The rudder pedals and joysticks are a must for students to taste virtual flying and learning topics related to science and technologies.
4	Six flight joysticks	
5	One laptop computer for preparing teaching materials	For developing learning and teaching resources.
6	One multimedia projector	For conducting lessons.
7	Two 3D printers	The 3D printers are required to construct models related to aviation and allow students to work with aircraft D&T to experience aircraft engineering. The printers can allow students to apply the skills of drawing and 3D printing and complete relevant learning tasks.
8	One laser cutter	The laser cutter is required to construct models related to aviation and allow students to work with aircraft D&T to experience aircraft engineering. The laser cutter can allow students to apply the skills of drawing and 3D printing and complete relevant learning tasks.
9	30 sets of experimental kits	For learning and teaching activities in tasting aircraft engineering and science experiments.
10	Two VR Systems	For learning and teaching activities in space exploration activities.
11	Some VR learning applications license	For learning and teaching activities in space exploration activities.
12	Two sets of accessories and stands for VR devices	Some protective accessories such as disposable covers, protective case and cover to keep the VR headset in good condition especially in the public area. A faulty device could project a bad image to the users.
13	One video recorder	For developing learning and teaching resources.
14	Web hosting and web platform service	For developing learning and teaching resources.

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

This project aims at developing school-based secondary STEM education through aerospace in physical facilities both to arouse students' career interest in learning STEM-related subjects and consolidate knowledge foundation, and to facilitate participating schools to acquire capability in designing and implementing their own programmes. Our school plans to develop the school-based STEM education programme for secondary students by reviewing the

learning activities and content suggested by curriculum guide of STEM-related subjects, adding three major learning modules (flight simulation, aircraft engineering and space exploration) for S1-S6. With the physical facilities, we can engage students in the inquiry-based learning activities to consolidate students' knowledge foundation in different STEM-related subjects leading to exploring study or career through aerospace.

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

Pull-out students will participate in extended learning activities in the air cadet programme to learn more about aviation studies and apply what they have learnt to solve the real-life problems. They need to share their learning experience after attending the programme. Their learning will be consolidated and their collaboration and problem-solving skills will be enhanced. All these can consolidate students' knowledge foundation in different KLAs leading to exploring study or career interest through aviation/ aerospace.

2.8 Budget

Total Grant Sought: HK$ **597,200**

Budget Categories	**Breakdown for the budget items**		**Justifications**
	Item	**Amount (HK$)**	
a. Staff	Project assistant (24 months, including MPF) (HK$14,300 × 24 × 1.05)	360,360	The candidate should have a university degree in computing or related disciplines. He/she will be responsible for: - arranging project activities and clerical work - preparing learning materials for the activities - photo taking and video recording - constructing a learning platform to share some learning materials on the website - assisting the teachers to design and compiling L&T resources
b. Service	A professional online platform	2,000	For developing learning and teaching resources.
	Web hosting service	600	For developing learning and teaching resources.
c. Equipment	Six high performance computers ($14,150 × 6)	84,900	For learning and teaching activities for flight simulation.
	($470 × 6)	2,820	For learning and teaching activities for flight simulation.
	Six flight rudder pedals ($600 × 4)	2,400	For learning and teaching activities for flight simulation.
	Six flight joysticks ($600 × 4)	2,400	For learning and teaching activities for flight simulation.
	One laptop computer for preparing teaching materials	5,000	For developing learning and teaching resources.
	One multimedia projector	6,200	For conducting lessons.
	One video recorder	4,000	For lesson observation, recording project activities and producing online learning resources.
	One 3D printer ($20,000 × 1)	20,000	For learning and teaching activities for tasting aircraft engineering.
	One laser cutter ($50,000 × 1)	50,000	For learning and teaching activities for tasting aircraft engineering.
	30 sets of consumable	12,000	For learning and teaching activities for

	experimental kits ($400 *x* 30)		tasting aircraft engineering.
	Two VR Systems ($13,299 *x* 2)	26,598	For learning and teaching activities for space exploration.
	Software licenses for VR learning applications license	1,500	For learning and teaching activities for space exploration.
	Two sets of accessories and stands for VR devices ($500 *x* 2)	2,000	For learning and teaching activities for space exploration.
d. General expenses	Audit fee	5,000	
	Printing and equipment for dissemination and evaluation measures	2,000	For collecting questionnaire to measure the effectiveness of the programme.
	Miscellaneous	524	Including photocopying and materials for learning activities etc.
e. Contingency		6,898	(b+c+d) *x* 3%
	Total Grant Sought (HK$):	**597,200**	

Our school will ensure that all procurement of goods and services is conducted on an open, fair and competitive basis with measures taken to avoid conflict of interests in the procurement process. The QEF general guidelines on management and monitoring of projects will be observed.

Assets Usage Plan

Category (in alphabetical order)	**Item / Description**	**No. of Units**	**Total Cost**	**Proposed Plan for Deployment** *(Note)*
audio and video equipment	Video Recorder	1	4,000	For lesson observation, recording project activities and producing online learning platform
computer hardware	High performance computer	6	84,900	For learning and teaching activities for flight simulation
	Laptop computer	1	5,000	For developing learning and teaching resources.
office equipment	Multimedia projector	1	6,200	For conducting lessons
Others	3D printer	1	20,000	All these items are used for learning and teaching activities for tasting aircraft engineering
	Laser Cutter	1	50,000	
	VR system	2	13,299	All these items are used for learning and teaching activities for space exploration
	Software licenses for VR learning application license	1	1,500	
	Accessories and stands for VR	2	2,000	

3. Expected Project Outcomes

3.1	Deliverables / outcomes	☑ Learning and teaching materials ☑ Resource package ☑ e-deliverables*(*please specify)*: A collection of teaching materials (reading, videos and lesson plans) will be delivered through online learning platforms. ☑ Others *(please specify)*: - Curriculum guideline to set up aerospace activities in schools. - Good practices of STEM learning and learning and teaching resources, including space exploration, flight simulation and aircraft engineering. - Students' work and promotion via STEM learning through aviation/ aerospace.
3.2	Positive impact on quality education/ the school's development	The project will align to the school plan and develop school-based STEM aerospace education in physical facilities both to arouse students' subject and career interest and consolidate interdisciplinary knowledge in STEM-related subjects through inquiry, and to facilitate teachers to acquire capability in designing and implementing STEM learning through teachers' development.

3.3 Evaluation

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

The project will be evaluated through quantitative and qualitative measurements including questionnaire surveys, observation, interviews and students' performance in the proposed activities. The key indicator of success would be their satisfaction of the aviation exposure (e.g. aerospace workshop, virtual flying experience, etc) and teaching resources deposited on the platform.

Performance indicator is student's satisfaction rating along several domains:

a) The effectiveness of the school-based STEM learning programme (success criteria: 80% of the teachers and students agree that the project helps the school promote STEM education);
b) To arouse academic and career interest by measuring motivational constructs on STEM through aviation activities (success criteria: 80% of the teachers and students agree that the project helps motivate students' learning and career interest in the aerospace learning activities);
c) Creative learning experience through STEM interactive activities in class and inquiry-based learning to enhance high order thinking (success criteria: 70% students helps enrich students' creativity and enhance their higher order thinking skills through inquiry based learning);

Performance indicator is teachers' satisfaction rating along several domains:

a) general practices on how to prepare and conduct the "first" aerospace lesson;
b) collective responsibility to share tangle and intellectual resources (incl. videos and teaching materials);
c) professional teachers' training development and network to learn from other schools.

This will be evaluated through a questionnaire survey by the participants, and if necessary, more schools beyond this list.

3.4 Sustainability of the project

By the end of the project, committee members and teachers involved will hold evaluation meetings. They will discuss how to further develop the school-based STEM education and design learning and teaching activities with different themes.

The maintenance fee and the purchase of new equipment of the "Aerospace Laboratory" 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.

Though our proposed laboratory and learning programme will be mainly served for the affiliated primary and our secondary school teachers and students, learning activities (e.g. EMI days, STEM induction and bridging courses, carnivals, gifted workshops and school open days) will still be arranged for neighbouring primary and secondary

students in future. The online learning website will share resources among schools. Just the simple maintenance of the website under our school should not be difficult with IT team in our school.

Aerospace is a starting point for STEM learning and teaching. When we are building up the platform, we will also refer to similar themes/projects elsewhere and share good STEM resources among schools.

3.5 Dissemination

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

- The school plans to organise learning workshops and sharing session for the teachers and students 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 deliverables will be uploaded to the school webpage and the Hong Kong Education City for teachers' reference.
- The eventually built platform will be opened for public access to share experience in aerospace classroom teaching. We accumulate and share through a school-hosted e-platform the good classroom practices and learning materials.

Report Submission Schedule

My school commit(s) to submit proper reports in strict accordance with the following schedule:

Project Management		**Financial Management**	
Type of Report and covering period	**Report due date**	**Type of Report and covering period**	**Report due date**
Progress Report 1/10/2019 – 31/03/2020	30/04/2020	Interim Financial Report 1/10/2019 – 31/03/2020	30/04/2020
Progress Report 1/04/2020 – 30/09/2020	31/10/2020	Interim Financial Report 1/04/2020 – 30/09/2020	31/10/2020
Progress Report 1/10/2020 – 31/03/2021	30/04/2021	Interim Financial Report 1/10/2020 – 31/03/2021	30/04/2021
Final Report 1/10/2019 - 30/09/2021	31/12/2021	Final Financial Report 1/04/2021 - 30/09/2021	31/12/2021