Quality Education Fund

The Dedicated Funding Programme for Publicly-funded Schools

Part B: Project Proposal

Project Title: School-based Creative STEM Learning Project	**Project Number:** *2018/1107*

Name of School: Wah Yan College, Kowloon

Direct Beneficiaries

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

(b) Beneficiaries: (1) Students: 480 students, 6 classes, 3 year levels; (2) Teachers: 15 ;
(3) Parents: 0; (4) Others: 0

Project Period: 06/2020 to 04/2023

1 Project Needs

1.1 Project Aims

The ultimate goals of STEM education are to strengthen students' ability to integrate and apply knowledge and skills across different STEM disciplines to solve real-world problems, and to nurture their creativity, collaboration and problem-solving skills, as well as to foster their innovation and entrepreneurial spirit as required in the 21st century, nurturing a pool of versatile talents with different sets and levels of skills to enhance the competitiveness of Hong Kong.

We believe there are 5 key areas of knowledge that must be learnt to bridge between the skills and ultimate goals mentioned, including: Robotics and Electronics, Coding, Computer Aided Manufacturing Methods, Computer Aided Design Methods, and Product Design Methods. Hence, the aim of this project is to develop knowledge and experience in the 5 key areas of knowledge. Since higher form students must focus on preparing themselves for the public examinations ahead, the target audience of this project are Secondary 1 to Secondary 3 students.

Another aim of the project is to train the teaching staff to be able to teach STEM education sustainably and develop knowledge, skills and teaching experience in the 5 key areas of knowledge mentioned above.

1.2 Innovative Elements

The project encourages hands on participation of students in various learning activities. Referencing theories of experiential learning, students are expected to have higher motivation of learning and longer knowledge retention rate than rote learning from lecturing. A new learning environment of the STEM room, funded by alumni patrons, would surely benefit this project by providing space for collaboration and participatory learning.

A key innovative element is the use of a project-based product design approach to tackle STEM education. Project-based learning helps to develop teamwork, application of inter-disciplinary knowledge, project management skills and presentation language skills. Electronic building blocks are utilized to implement project-based product design learning of STEM knowledge. Electronic building blocks replace conventional circuit models and apparatus, are much simpler to use and encourage students to use them to develop functional prototypes for designs to tackle real life cases. Electronic building blocks consist of coding blocks and logic gates blocks. We notice that using coding to tackle STEM education may be a hasty generalization. Electronic building blocks offer a much more analog approach to electronics and circuit building and are closer to the real-life scenario. Coding can also be implemented if the case requires higher level of logic behind it.

1.3 Alignment with school-based / students' needs

The core disciplines of STEM education: Integrated Science, Technology Education and Mathematics are now all parts of the eight Key Learning Areas, in which all students are entitled to study. We recognise the importance of STEM education. This view is also echoed by the External School Review Report of the Quality Assurance Division of the Education Bureau in their inspection conducted in 2011. The report recommends that "more time should be allotted to Technology Education in S2 and S3." (2011).We reckon that STEM education would be a perfect opportunity for us to regain progress in this subject matter. To satisfy this need, the school has already planned to reform the school timetable by adding an extra Computer Literacy lesson weekly and merging the lessons into a double period to reduce time lost in the lesson transition. Elements of disciplines from the Technology Education curriculum other than ICT are also introduced to the school-based curriculum.

The school recognizes the importance of STEM KSA development to our students' development and wellbeing. Science and Engineering is a popular choice of disciplines among students for further studies. It is important for us to build a strong and firm base for them to go further in their career, let alone keeping them abreast of the changing times. To explore opportunities for innovative technological development in the Greater Bay Area, we bear great responsibility to equip our students with knowledge, skills and abilities.

2 Project Feasibility

2.1 Key concept (s) / rationale(s) of the project

This project stands on the shoulders of giants that proposed the Maker movement for education. Despite being popular among western countries, the majority of Hong Kong's educators do not seem to bat an eye upon this culture of creating. Martin Lee believed that bringing Making into K-12 education can enhance opportunities for students to engage in design and engineering practices, specifically STEM/STEAM practices (2015). We embrace the effectiveness of Making on STEM education as it engages the students to participate and learn by experiential learning. Ironic as it may seem, we believe experiential learning would be more effective for Hong Kong learners than rote learning, which we have been practising for the past decade.

There is no set definition of making, from integration of the definitions of Honey and Kanter (2013), Sheridan et al (2014), Kuznetsov and Palos (2010) et cetera. We would like to adopt the definition of Making by Lee (2015), as "The process of creation that involves traditional craft techniques, digital technology that is incorporated within the design and for manufacturing." We hope to motivate our students to learn STEM related knowledge to achieve Maslow's self actualization through stimulation by Making activities. Kalil (2013) suggested that "people who design and make things on their own time because they find it rewarding to make, tinker, problem-solve, discover and share what they have learned." Lee described there are three elements of Making and the Maker Movement that are critical for understanding its promise for education: Digital Tools, Community Infrastructure and the Maker Mindset. These three elements correspond to the government's ultimate goal of STEM education. Digital tools prepare the younglings of Hong Kong with different sets and levels of skills to enhance the competitiveness of Hong Kong; Community Infrastructure fosters the entrepreneurial spirit and collaboration with institutes of the Greater Bay Area; and the maker mindset develops students' innovation, creativity and problem-solving skills.

Design and Technology (DT) was perceived as an industrial and vocational training kind of subject in the 20th Century, and soon it has been shunned by parents, teachers and students alike. But there is still value to it, as the design process and production methods are important for makers. Dewey (1916) was very careful when he was explaining his view in an era that pre-dates the movement of STEM education. That activities in school should model those experience outside of school that we find engaging and fulfilling. Rather than focusing on preparation for future careers, he argued that focusing on the present value of experiences would prepare the students for continual growth.

As DT's successor, the Makers' approach to STEM learning reinvents this out-of-date subject by giving it modern-day elements. Instead of working with traditional resistant materials like metals, wood and plastic, students will learn and methodologies like 3D design, laser cutting and 3D printing. These digital manufacturing tools allow students to produce prototypes rapidly. Robotics and coding knowledge allow students to add functionality to the products. The massive increase of efficiency in production allows students to use the saved time to learn applicable knowledge, skills and attitudes of STEM subjects.

Rather than challenging students with straight forward, simplified problems, students would be given complex and realistic problems that are simulations of real-life experiences in our STEM curriculum. To be discussed in criterion 2.7, the curriculum we propose is a thematic, interdisciplinary unit centered on an engineering design challenge. Not only do these themes interconnect with the existing Integrated Science curriculum, it also stimulates the students to make a personal connection to the experience, hence elongating knowledge retention. As Lesh et al stated (2000), it is important for students to try to make sense of the situation based on extensions of their personal knowledge and experiences.

Dare, Pettis and Moore created the Wind Turbines unit (2013) and provided the basis for hands on STEM education. The unit involved students investigating the shape and number of blades, and where to place the wind turbines on the school campus. The process of Making allowed students to collaborate and work as a group, which is another essential component of STEM learning. This is what we want to recreate in our school, embodied knowledge, where knowledge and abilities are organized around experience, as Sriraman and Lesh suggested (2007).

The discussion can be illustrated by two education models: Figure 1: The Lesh Translation Model, and Figure 2: The STEM Translation Model.

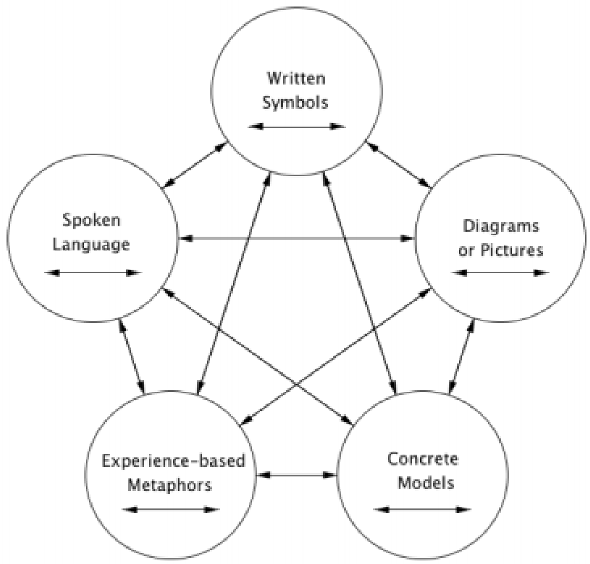

Fig. 1

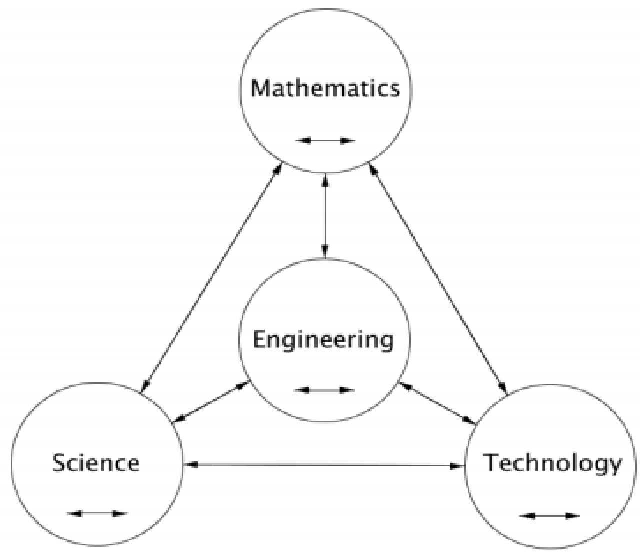

Fig. 2

The Lesh transition model illustrates the importance of each way of knowing to maximize students' conceptual understanding. The process of making allows students to be engaged in the learning experience. Ordinary lecture-based rote learning can only satisfy the 'Spoken Language', 'Diagrams of Pictures' and in some cases 'Written Symbols', whereas a project-based STEM learning that integrates Making should be able to satisfy all five components.

Our product design approach to STEM asks students to apply the ideas, skills and techniques from one discipline of the STEM Translation Model to tackle problems in another (Glancy and Moore, 2013). This would help students to perceive relationships, similarities and differences between disciplines of STEM. In traditional classroom learning where each subject has its own lessons, students see the concept in its two different manifestation and are unable to make connections between them. On the contrary, the product design approach allows students to undergo a process of convergent cognition, as suggested by Rich, Letham and Wright (2012). Where a synergistic relationship combining two or more subjects reveals a more complex object.

In summary, bringing Making and Product Design to our school as an approach to STEM education has the potential to bring creative, playful, engineering and design-relevant learning.

Bibliography

Dewey, John. Democracy and Education; an Introduction to the Philosophy of Education. Macmillan, 1916.

Glancy, Aran W., and Taamara J. Moore. "Theoretical Foundations of Learning Environments." School of Engineering Education Working Papers, 2013.

Honey, Margaret, and David Kanter. Design, Make, Play: Growing the next Generation of STEM Innovators. Routledge, 2013.

Kuznetsov, Stacey, and Eric Paulos. "Rise of the Expert Amateur." Proceedings of the 6th Nordic Conference on Human-Computer Interaction Extending Boundaries - NordiCHI '10, 2010, doi:10.1145/1868914.1868950.

Lesh, R. and Zawojewski, J.S. (2007) Problem Solving and Modeling. In: Lester, F., Ed., Second Handbook of Research on Mathematics Teaching and Learning, Information Age Publishing, Greenwich, CT, 763-802.

Martin, Lee. "The Promise of the Maker Movement for Education." Journal of Pre-College Engineering Education Research (J-PEER), vol. 5, no. 1, 2015, doi:10.7771/2157-9288.1099.

Rich, Peter J., et al. "Convergent Cognition." Instructional Science, vol. 41, no. 2, 2012, pp. 431–453., doi:10.1007/s11251-012-9240-7.

Sheridan, Kimberly, et al. "Learning in the Making: A Comparative Case Study of Three Makerspaces." Harvard Educational Review, vol. 84, no. 4, 2014, pp. 505–531., doi:10.17763/haer.84.4.brr34733723j648u.

Sriraman, Bharath, and Richard Lesh. "A Conversation With Zoltan P. Dienes." Mathematical Thinking and

Learning, vol. 9, no. 1, 2007, pp. 59–75., doi:10.1080/10986060709336606.

2.2 Applicant's readiness or ability/ experience/ conditions/ facilities for project implementation

The school has set a 5-year development plan for STEM education, which incorporates architectural plans of the STEM Laboratory, strategical curriculum planning, participation in STEM activities, collaboration with STEM institutes and professional training for teachers. The objectives are to engage students in STEM learning experiences for at least three years to equip them to be creative problem-solvers and ensure the sustainable development of STEM education.

With the generous aid of alumni patrons, the school's STEM laboratory will begin its construction in the 2019-2020 academic year and would be ready for use once completed. It would be a makerspace for students to actively participate in STEM learning activities.

The school has already begun reforming the school-based curriculum and increased human resources employed to support our development in STEM education. Cross-curricular project-based learning activities are now part of our curriculum, and students are able to put knowledge from different subjects into practical use to enhance their retention and to promote interest in STEM subjects. The latest computer literacy syllabus incorporates various areas of knowledge in STEM, including block programming and 3D design. A course has been held to promote interest in coding and engineering for 15 students from junior form levels to participate.

The school has formed a STEM development committee, a committee of experienced teachers from various STEM related subject departments, including Technology Education, Science and Mathematics. Two of our teachers have been interflowed to the Science Department of Curriculum Development Institute as well as IT in Education in EDB. We have also recruited teachers to join the Mathematics and Information Communication Technology Department to satisfy human resources demanded by the school's STEM development.

2.3 Principal's and teachers' involvement and their roles

The Principal, Senior Teachers of the Science Department, Teachers of the ICT Department and Senior Teachers of the Mathematics Department shall form a core committee for the project. The principal shall supervise, promulgate and coordinate all activities of the project.

The ICT Department would take the lead of the project, and all teachers of the said department are involved to execute the project. The core committee members shall be responsible for the design of student activities and procurement duties. All teachers of the said department should contribute to the preparation, discussion, observation and evaluation of the project.

Representatives of the core committee should regularly share the project progress with the Parents Association and other teachers at school, especially teachers teaching STEM related subjects. The progress of the project will be reported to the IMC of the school regularly.

Technical Supporting Staff, teaching assistant and assistant teachers should participate in all STEM activities by providing support in experiments and activities.

Rank	Duties and roles in the project
The Principal	Be responsible for supervision, promulgation and coordination; Review the project and utilization of resources; Invite other schools to exchange experience and hence develop networks.
Senior Teacher of the Science Department / Senior Teacher of the ICT Department	Be the Project Leader; Coordinate lesson design and development; Monitor progress and quality; Monitor the budget and expected project outcomes; Evaluate project progress and effectiveness regularly;
ICT Teachers	Engage in technical planning and execution coordination; Design lesson content, needs and usage of teaching resources; Execute project goals.
Science Teachers / Mathematics Teachers	Execute project goals; Monitor progress and quality.
Lab Technician / TSS / TA / AT	Provide support for all teaching activities; Review experiment activities, required apparatus and teaching materials.

2.4 Parents' involvement / participation (if applicable)

The school scheduled "students' work exhibition cum STEM symposium" at the end of each academic year. Parents are invited to participate to appreciate students' work. As the project continues to the second and the third year, S2 and S3 students will be engaged in product design projects. Parents are invited to see their work, give comments and vote out the design of the year. A committee of IS and ICT teachers will also give their opinion and verdicts on each project. Finally, the best works of the year will be elected and awards will be given to the students.

2.5 Roles of collaborator(s) (if applicable)

NIL

2.6 Implementation timeline

Implementation period *(MM/YYYY)*	Project activities
06/2020	Procure required hardware, equipment and service for the project in an open, fair and competitive basis with measures taken to avoid conflicts of interests in the procurement.
08/2020	Staff's professional development on teaching with electronic building blocks, 3D methods and safety, teaching methods of project-based product design approach of STEM for the needs of the curriculum of Year 1 of the project
09/2020	Year 1 of the project commences. The Secondary 1 students in 2019-2020 academic year will be taught the project's STEM and ICT curriculum instead of the sole ICT curriculum.
01/2021	Mid-year evaluation of project progress
07/2021	Dissemination of Project Outcomes
08/2021	End of year evaluation of project progress.
08/2021	Staff's professional development on teaching with electronic building blocks, 3D methods and safety, teaching methods of project-based product design approach of STEM for the needs of the curriculum of Year 2 of the project.
09/2021	Year 2 of the project commences. The Secondary 1 and 2 students in 2020-2021 academic year will be taught the project's STEM and ICT curriculum instead of the sole ICT curriculum.
01/2022	Mid-year evaluation of project progress
07/2022	Students' work exhibition cum STEM symposium
07/2022	Dissemination of Project and Outcomes
08/2022	End of year evaluation of project progress.
08/2022	Staff's professional development on teaching with electronic building blocks, 3D methods and safety, teaching methods of project-based product design approach of STEM for the needs of the curriculum of Year 3 of the project.
09/2022	Year 3 of the project commences. The Secondary 1,2 and 3 students in 2021-2022 academic year will be taught the project's STEM,ICT curriculum instead of the sole ICT curriculum.
03/2023	Students' work exhibition cum STEM symposium
03/2023	Dissemination of Project Outcomes
04/2023	End of year evaluation of project progress

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

a. ***Student activities***

The project shall reform the school-based curriculum of Information Communication Technology. Approximately 30 lessons per year would become STEM lessons. The school timetable has a double period for ICT lessons per week and therefore each session will be of TWO thirty-five-minute lessons.

Learning Activities for Secondary 1 Students

Activity Number	Activity name	Content	Number of sessions, duration (mins)	Expected learning outcomes
1.1	Building a windmill with electronic building blocks	IS 5.1 Energy changes 5.3 Energy sources TE E6 System Integration E7 Control and Automation K6 Production Process K9 Application of Systems	1, 70	● Recognise that energy exists in different forms (chemical energy, electrical energy, kinetic energy, light energy, potential energy, sound energy and thermal energy). ● Recognise that different forms of energy can be converted from one form to another. ● Mechanical, electrical, electronic and pneumatic control systems ● Identification and application of building blocks/modules of the electronic systems including the input, processing and output devices ● Functions of common components in a pneumatic system and recognise the related symbols ● Model control systems ● Construction kits for model and simulate technological solutions ● Design of simple systems to meet specified problems ● Proper use of a range of appropriate machines to implement solutions to design problems ● Basic concepts of and 3D modeling ● Application of IT tools such as software to present design ideas
1.2	Building a solar powered car with electronic building blocks		1, 70	
1.3	Building a robotic arm with electronic building blocks		1, 70	
1.4	Building a torch with electronic building blocks		1, 70	
1.5	Introduction to 2D and 3D Computer Aided Design and Manufacturing	K6 Production Process	1, 70	● Basic elements of Design: o Design consideration o Production process in various fields
1.6	Checking water turbidity and Total Dissolved Solid with electronic building blocks sensors. Compare turbidity and Total Dissolved Solid with of sea water, muddy water, pond water, tap water and distilled water	IS 2.3 Water Purification	1.5, 105	● State some impurities in natural water. ● State the needs for pure water. ● Understand the processes involved in different methods of water purification (sedimentation, filtration).
1.7	Design and produce a water purification setup with and manufacture with a 3D Printer.		1.5, 105	

1.8	Introduction to analog circuit designs and application of mechanisms	K8 Concepts of Systems, K9 Application of Systems	0.5, 35	● Input, process and output: ● Various forms of systems: mechanical, electrical, electronic as well as their principles of operations. ● Analysis and identification of control systems as input, process and output elements and feedback. ● Mechanical, electrical electronic control systems: ● Advantages and limitations of using mechanical, electrical, electronic control systems ● Applications of different control systems in everyday life
1.9	Logic gate training with electronic building blocks		4.5, 315	
1.10	Product Design Training: Workback the product design process of daily life electronic appliances.		2, 140	

Learning Activities for Secondary 2 Students

Activity Number	Activity name	Content	Number of sessions, duration (mins)	Expected learning outcomes
2.1	Measuring air CO2 Concentration Calibrating a digital device	IS 7.1 Air; ICT K16 Information Processing and Presentation	0.5, 35	● Recognise that air is a mixture of gases. ● State the percentage of main gases in air.
2.2	Comparing CO2 concentration of expired air before and after exercise	IS 7.3 Respiration; IS 7.4 Gas Exchange in Plants and animals; TE K16 Information Processing and Presentation"	0.5, 35	● Recognise that the chemical energy stored in food can be changed by our body into other useful forms of energy to support body activities. ● Describe respiration as a process in which food is broken down in cells to release energy.
2.3	Comparing CO2 concentration outside leaves under different conditions	IS 7.2 Photosynthesis; IS 7.4 Gas exchange in plants and animals; TE K16 Information Processing and Presentation	0.5, 35	● Recognise that photosynthesis is the process that plants make their own food. ● State that light energy is converted to chemical energy in food during photosynthesis in plants. ● Write the word equation of photosynthesis. ● Write the chemical equation of photosynthesis. ● Understand that the net gas exchange in plants depends on the relative rate of photosynthesis and respiration taken place.
2.4	Process data collected from an experiment.	IS 7.2 Photosynthesis; IS 7.4 Gas exchange in plants and animals; TE K16 Information Processing and Presentation	0.5, 35	● Use of office automation software to prepare daily routine ● Understand Spreadsheet features including: o cell references, simple functions, basic mathematical operators, formatting features, multiple worksheets o error values associated with the use of formulae o data manipulation: simple filtering and sorting o charts with two or more sets of data ● Error detection by verification and validation

2.5	Intermediate 2D and 3D Computer Aided Design and Manufacturing	K4 Structure and Mechanisms, K6 Production Process	1, 70	● Simple properties of structures and movement ● Use of mechanisms for transmission and control of movements
2.6	Learn to build a circuit and basic coding with electronic building blocks, blocky programming or Coding	IS 8.1 Simple circuit, K16 Information Processing and Presentation	1, 70	● Computer is a machine which operates according to the following sequence: - “input → process → output”. ● Recognise that the cell is the energy source in a circuit. ● Understand a switch as a device to open or close a circuit. ● Recognise the circuit symbols (cell, battery, light bulb, switch, ammeter, voltmeter, resistor and rheostat). ● Draw and interpret simple circuit diagrams. ● Importance of the stored program in an automated processing task and using programs to control the computer ● Input simple programs into the computer, execute and modify the programs, observe results of the programs, and save the programs for retrieval at a later stage.
2.7	Smart City Design: Thermostatic Room		1, 70	
2.8	Smart City Design: Carpark Gate		1, 70	
2.9	Smart City Design: Traffic Light System		2, 140	
2.10	Smart City Design: Car park navigation System		2, 140	
2.11	Building a Crane with electronic building blocks, 3D printed and laser cut materials	IS Unit 11. 1 Motion, 11.2 Force, 11.4 Friction and air resistance K4 Structures and Mechanisms	1.5, 105	● Recognise the relationship between average speed, distance and time. ● State that metre per second (ms-1) is a unit of speed. ● Represent a motion using a distance-time graph. ● Interpret a distance-time graph. ● Identify uniform motion and non-uniform motion. ● Recognise that friction and air resistance are forces that oppose the motion between contact surfaces. ● State that forces can act at a distance. ● Give examples of contact forces and noncontact forces.
2.12	Braking System electronic building blocks, 3D printed and laser cut materials		1.5, 105	
2.13	Building a Speed Monitor electronic building blocks, 3D printed and laser cut materials		2, 140	

__Learning Activities for Secondary 3 Students__

Activity Number	Activity name	Content	Number of sessions, duration (mins)	Expected learning outcomes
3.1	Introduction to the Product Design Life Cycle	K6 Production Process	1, 70	● Design Process, Design Consideration
3.2	Identify problems, draft design briefs and design specifications	Smart home design for the visually impaired	1, 70	● Identify and solve their own design problems and understand how to reformulate problems given to them. ● Understand the principle of circuit design.
3.3	Build functional prototypes with electronic building blocks and paper		1, 70	
3.4	design of products with 3D software		1, 70	
3.5	Manufacturing and Assembly of the Final Product		1.5, 105	
3.6	Presentation of portfolio and the Final Product		0.5, 35	
3.7	Introduction to and setup device	K4 Structures and Mechanisms	1, 70	● Examples of innovative technological devices that improve QoL
3.8	Coding and Building Circuits	K2 Programming Concepts	1, 70	● Ideas of a stored program
3.9	Integration of and Coding		1, 70	
3.10	Identify problems, draft design briefs and design specifications	Smart city design to solve urban problems with IOT and Coding	1, 70	● Identify and solve their own design problems and understand how to reformulate problems given to them. ● Understand the principle of circuit design.
3.11	Build functional prototypes with electronic building blocks and paper		1, 70	
3.12	design of products with 3D software		1, 70	
3.13	Setup devices and Coding Devices		0.5, 35	
3.14	Manufacturing and Assembly of the Final Product		2, 140	
3.15	Presentation of portfolio and the Final Product		0.5, 35	

Supplementary information of how the learning elements under the TEKLA curriculum are to be included in the proposed learning activities.

Activity Number	Activity name	TEKLA Learning Elements:	Content
1.1	Building a windmill with electronic building blocks	(K6) Production Process (K9) Application of Systems	**<u>Basic elements of Design:</u>** Design fundamentals **<u>Design consideration</u>**: Examples on design & make of daily products. Disassembly & critics of simple technological product parts, materials, and working principles. Appropriate processing methods on a range of materials in a safe and correct manner for making products and systems **<u>Mechanical, electrical, electronic and pneumatic control systems:</u>** Functions of basic electronic and electrical components, devices and simple theories. Identification and application of building blocks/modules of the electronic systems including the input, processing and output devices.
1.2	Building a solar powered car with electronic building blocks		
1.3	Building a robotic arm with electronic building blocks		
1.4	Building a torch with electronic building blocks		
1.5	Introduction to 2D and 3D Computer Aided Design and Manufacturing	(K6) Production Process	**<u>Basic elements of design</u>**: Basic concepts of and 3D modeling. Application of IT tools such as software to present design ideas. **<u>Production process in various fields:</u>** Appropriate processing methods on a range of materials in a safe and correct manner for making products and systems. Examples on a range of equipment that is used in production process, e.g. laser cutter and 3D printer.
1.6	Checking water turbidity and Total Dissolved Solid with electronic building blocks sensors. Compare turbidity and Total Dissolved Solid with of sea water, muddy water, pond water, tap water and distilled water	(K9) Application of Systems	**<u>Mechanical, electrical, electronic and pneumatic control systems:</u>** Functions of basic electronic and electrical components, devices and simple theories. Identification and application of building blocks/modules of the electronic systems including the input, processing and output devices.
1.7	Design and produce a water purification setup with and manufacture with a 3D Printer.	(K6) Production Process	**<u>Basic elements of design</u>**: Basic concepts of and 3D modeling. Application of IT tools such as software to present design ideas. **<u>Production process in various fields:</u>** Appropriate processing methods on a range of materials in a safe and correct manner for making products and systems. Examples on a range of equipment that is used in production process, e.g. laser cutter and 3D printer.

1.8	Introduction to analog circuit designs and application of mechanisms	(K8) Concepts of Systems, (K9) Application of Systems	**<u>Input, process and output</u>:** Analysis and identification of control systems as input, process and output elements and feedback **<u>Mechanical, electrical, electronic and pneumatic control systems:</u>** Functions of basic electronic and electrical components, devices and simple theories. Identification and application of building blocks/modules of the electronic systems including the input, processing and output devices.
1.9	Logic gate training with electronic building blocks		
1.10	Product Design Training: Workback the product design process of daily life electronic appliances.		
2.1	Measuring air CO2 Concentration Calibrating a digital device	K16 Information Processing and Presentation	**<u>Information processing and information processing tools:</u>** Spreadsheet features including: cell references, simple functions, basic mathematical operators, formatting features, multiple worksheets, error values associated with the use of formulae, data manipulation: simple filtering and sorting, charts with two or more sets of data
2.2	Comparing CO2 concentration of expired air before and after exercise		
2.3	Comparing CO2 concentration outside leaves under different conditions		
2.4	Process data collected from an experiment.		
2.5	Intermediate 2D and 3D Computer Aided Design and Manufacturing	K4 Structure and mechanisms, K6 Production Process	**<u>Different structure design for various needs</u>**: Awareness of different structures and mechanisms can enhance the functionality of various designs to suit different needs. Application of appropriate structures in design with considering the state of equilibrium and weak points **<u>Basic elements of design:</u>** Basic concepts of and 3D modeling. Application of IT tools such as software to present design ideas. Animating of design ideas in computer animation or video clips. Design critique and appreciation in design
2.6	Learn to build a circuit and basic coding with electronic building blocks, blocky programming or Coding	(K2) Programming Concepts K16 Information Processing and Presentation	**<u>Ideas of a stored program</u>**: Importance of the stored program in an automated processing task and using programs to control the computer. Input simple programs into the computer, execute and modify the programs, observe results of the programs, and save the programs for retrieval at a later stage. **<u>Computer and computer operation:</u>** Computer is a machine which operates according to the following sequence: - "input → process → output".
2.7	Smart City Design: Thermostatic Room		
2.8	Smart City Design: Carpark Gate		
2.9	Smart City Design: Traffic Light System		
2.10	Smart City Design: Car park navigation System		
2.11	Building a Crane with electronic building blocks, 3D printed and laser cut materials	K4 Structures and Mechanisms (K6) Production Process	**<u>Simple properties of structures and movement:</u>** Classification of motions, such as linear, rotary, oscillatory and reciprocator. **<u>Different structure design for various needs:</u>** Awareness of different structures and mechanisms can enhance the functionality of various designs to suit different needs. Application of

2.12	Braking System electronic building blocks, 3D printed and laser cut materials		appropriate structures in design with considering the state of equilibrium and weak points **<u>Use of mechanisms for transmission and control of movements</u>** Application of common mechanical components to convert and control motion, such as drive systems and rotating shafts, belts and pulleys **<u>Production process in various fields:</u>** Appropriate processing methods on a range of materials in a safe and correct manner for making products and systems. Examples on a range of equipment that is used in production process, e.g. laser cutter and 3D printer.
2.13	Building a Speed Monitor electronic building blocks, 3D printed and laser cut materials		
3.1	Introduction to the Product Design Life Cycle	(K2) Programming Concepts (K4) Structures and Mechanisms (K6) Production Process (K16) Information Processing and Presentation	**<u>Design consideration</u>** Ergonomic concerns and industrial standards in making appropriate solutions. Critical assessment on products and system design. **<u>Product design</u>** Roles of designers and engineers at work. Organisation of resources and processes for making simple products or models of proposed solutions. Comparison of appropriate processes, instruments and materials to be used for the making processes. Evaluation of the quality of production system, products or environments against various essential factors. Product Maintenance. Safety measures, precautions and standards required for making the products. **<u>Basic elements of design</u>**: Presentation of design ideas in 2D and 3D using free-hand sketching and projection views (e.g. sketching, perspective and isometric drawing, 3D modeling) **<u>Design process</u>**: Identification of a simple current technological problem. Application of various design methods in problem solving (e.g. factor analysis, lateral thinking, mind map, brain-storming). Communicating a problem, design or solution using drawings and words. Investigation on different areas & proposing solutions to the problem. Designing and building models by using different materials and test the selected functional characteristics of the models built. Implementation of a solution by constructing a device using materials provided. Evaluation of solution on whether it meets the goals. Suggestion of improvement to the solution. Recognition of the concepts used in the design cycle and apply them in solving problems
3.2	Identify problems, draft design briefs and design specifications		
3.3	Build functional prototypes with electronic building blocks and paper		
3.4	design of products with 3D software		
3.5	Manufacturing and Assembly of the Final Product		
3.6	Presentation of portfolio and the Final Product		
3.7	Introduction to and setup device		
3.8	Coding and Building Circuits		

3.9	Integration of and Coding		**<u>Information processing and information processing tools:</u>** Word processing features may include: - formatting (tables and text frames) - hyperlink - checkers (e.g. spelling checker and word count). Spreadsheet features may include: - cell references, simple functions, basic mathematical operators, formatting features, multiple worksheets - error values associated with the use of formulae - data manipulation: simple filtering and sorting - charts with two or more sets of data. **<u>Data manipulation:</u>** Input and output features of a program: to accept input from keyboard and output information to the screen. Variables and simple arithmetic operations in assignment tasks. Simple commands to manipulate text strings, display text with interesting effects and generate sound in the programming environment. Relational operators (>, >=, <=, = and <>) and logical operators (AND, OR and NOT). Daily life examples of the use of looping. Simple programs with flow control statements and loops.
3.10	Identify problems, draft design briefs and design specifications		
3.11	Build functional prototypes with electronic building blocks and paper		
3.12	design of products with 3D software		
3.13	Setup devices and Coding Devices		
3.14	Manufacturing and Assembly of the Final Product		
3.15	Presentation of portfolio and the Final Product		

b. Teacher training, if applicable

Training should take place out of lesson hours.

Activity Number	Activity name	Content	Duration (Hours)	Hired personnel	Expected learning outcomes
T.1	3D and teaching methods	-Learning how to use a 3D software -Integration of 3D with mathematics and geometry -Joining methods of materials	6	To ensure the sustainability of the project, teaching staff must undergo professional training in order to properly teach and run the programme. Training should be taught by professionals and 3rd party training providers who have experience in running such programmes in other schools. Hardware training should ideally be taught by the vendor of such machines as they should be	Be able to use software to design 3D and 2D objects to be . Provide guidance in projects.
T.2	3D with 3D Scanner		3		
T.3	Operating a laser cutter	Operating a laser cutter, calibration, materials knowledge, laser safety, software operation, integration with and maintenance.	2		Be able to operate a laser cutter and aware of safety hazards.
T.4	Operating a 3D	Operating a 3D printer, calibration, materials knowledge, software operation, integration	2		Be able to operate a 3D printer and aware of safety hazards.

	printer	with and maintenance.		most familiar with them.	
T.5	How to teach with electronic building blocks	Basics of electronic building blocks, usage of , project-based learning with electronic building blocks, scenario training, coding with electronic building blocks.	9		Be able to teach STEM projects with electronic building blocks. Manage projects and provide guidance.
T.6	How to teach coding with block programming and	-Basics of block programming, integrating block programming into robots - coding language -Operating a microcontroller with code.	6		Be able to teach block and C programming and provide guidance in projects.
T7	Product Design and Project based teaching	-Product design life cycle -Integrate curriculum knowledge into product design and project based learning. -Project-based teaching management.	6		Be able to lead students to undergo the product design life cycle and manage projects.

c. Example of STEM Lesson Plan:

Teacher:	Year Level: S1
Lesson Duration: 70 minutes	Activity: Building a solar powered car with electronic building blocks
Date:	

Lesson Summary：

Infuse STEM , arrange the following activities for S1 students.
Introduce the function and application of the DC motor electronic building block.
Improve students' understanding of the concept of energy conversion.
Enhance students' ability to work with and STEM teaching tools and modules.

Expected Learning Outcomes：

After this lesson, students should be able to:
1. Design a Mars Rover incorporating a DC motor.
2. Understand the concept of energy conversion, that the Mars Rover receives energy from the sun and converts it to kinetic energy.
3. Develop interest in scientific exploration and technology, actively participate in learning activities and to learn in a self-directed manner.
4. Develop a good ICT learner profile, so that they can use ICT effectively and ethically.

Key learning area:
Science and technologies around us, understanding the world in the informative generation

Teaching aims:

1. Knowledge：
    - Actively participate in scientific investigation, understand the scientific workflow.
    - Understand the importance of science and technology to the development of society, and its impact on the environment.
    - Practise living green.

2. Skills：
    - From the process of designing and making, solve daily life problems.
    - Develop communication skills, problem solving skills, collaborative skills, creativity and critical Thinking.
    - Computing a spreadsheet and producing charts from it

3. Values and attitude：
    - Develop an interest to explore the world from a scientific and technological point of view.
    - Develop a good ICT learner profile, so that they can use ICT effectively and ethically.

Learning objectives:
After the lesson, students should be able to:

1. Tell the features of different materials and usage.
2. Design and make from daily life materials.
3. Tell the source of energy and their application in daily life.
4. Give examples of energy conversion.
5. Understand basic mechanics: wheels and rollers
6. Apply the product design life cycle to design and manufacture a product.
7. Tell how technology and science has shaped our daily lives.
8. Understand Safety and Responsibility in Science and Technology activities.

Teaching apparatus：
Electric Cables*1 Solar Panel*1 3D Printed Rover Parts*1 Cardboard
Scissors Masking Tape Stopwatch Strings Coloured Paper Drinking Straws Skewer sticks Glue gun 3D printed/ Laser cut wheels Wooden Rover Body Other Crafting tools

Venue: Roof top or playground with plenty of direct sunlight

Time (mins)	Procedure	Activity	Questions/ Lecture/ Instructions	Arrangement	Resources	KSAO
5	Initiation	Students do pre-lesson preparation and answer questions	What are the types of energy? What is energy conversion? What are sustainable sources of energy? What is green energy?	Slideshow		Make a hypothesis, Communication skills
5	Development	Explain, elaborate and clarify concepts	Introduce the basics of solar power, solar panels, its materials and limitation. Elaborate that all energy on Earth comes from the sun.	Slideshow		Think, discuss and share.
5	Development	Demonstrate, distribute materials, elaborate	Teacher showcases the solar rover. Ask the students about the function of each part. Elaborate on mechanics of wheels and rollers.		Teacher's model	Think, discuss and share.
10	Development	Small group activity	Students use electronic building blocks to construct a circuit. Measure the dimensions of the blocks. Design and produce the rover.		Teacher instructs students to test the 3 modes of a DC motor.	Communication skills, critical thinking, creativity, problem solving skills, collaborative skills.
5	Transit		Finalize product, pack up and clean materials. Transit to the roof top or playground for a test run.			Scientific investigation, basic workflow of science and technology activities.
25	Development	Test	Test each group's rover, instruct students to record experiment results.		Worksheets, stopwatch, strings	

5	Transit		Pack up materiasl, return to STEM lab			
5	Reflection and Conclusion	Students present the conclusion	Students do reflection on what they have learnt and mastered and conclude the lesson.	Slideshow		
	Extension		-Complete the worksheet. Use appropriate graphs and charts to demonstrate the experiment results. -Do research on the use of solar panels to generate sustainable energy in Hong Kong. -Do research on how the Mars Rover works.			Make a logical hypothesis. Using a spreadsheet to compute and generate graphs and charts.

d. "STEM Laboratory" recommended usage timetable (starting from the 2019-20 school year):

In addition to arranging the STEM Innovation Learning Activities mentioned above, the school is also planning to arrange some of the following subjects in the creative space for classroom activities. It is expected that resources will be used to support interdisciplinary learning, and STEM education is integrated into the regular classroom, and the details are as follows:

Subject	Grade	Time
ICT	S1-S3	On average 1 double lesson per class per month
IS	S1-S3	On average 1 single lesson per class per month
After-school activities (Incubation Hubs / Cross Curricular activities)	Students who participate in the STEM Club and the "STEM Design and Application Competition"	In the after-school hours (about 45 minutes to 1 hour) under the supervision of teachers.

In addition, the school plans to hold community STEM workshops and seminars for teachers in the same district in the "STEM Laboratory" every year.

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

Item	Details of equipment to be procured	Contribution to fulfilment of the project aim(s) and if applicable, the expected utilization rate
1	ONE SET of Pro Library Electronic Building Blocks and Logic Gates Bundle	Essential for the completion of student activity 1.1, 1.2, 1.3, 1.4 1.6, 1.8, 1.9, 1.10, 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 3.2, 3.4, 3.6, 3.7, 3.8, 3.10, 3.12, 3.13, of session 2.7a and club session mentioned in 2.7h.
2	EIGHT SETS of Workshop set Electronic Building Blocks	Essential for the completion of student activity 1.1, 1.2, 1.3, 1.4 1.6, 1.8, 1.9, 1.10, 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 3.2, 3.4, 3.6, 3.7, 3.8, 3.10, 3.12, 3.13, of session 2.7a and club session mentioned in 2.7h.
3	Electronic Building Blocks (50 units)	Essential for the completion of student activity 3.6, 3.8, 3.12, 3.13 of session 2.7a and club session mentioned in 2.7h.
4	ONE SET of Professional high-precision 3D Scanner	Essential for the completion of student activity 1.5, 1.7, 2.5, 2.11, 2.12, 2.13, 3.3, 3.4, 3.11, 3.13 of session 2.7a and club session mentioned in 2.7h.
5	ONE SET of STEM Sensors supplementary for Projects Light/Sound/Temperature/Motion, Waterproof Temperature, etc)	Essential for the data collection in the experiment of student activity 2.1, 2.2, 2.3 and 2.4 of session 2.7a.
6	TWELVE SETS of Advanced Kit for STEM projects	Essential for the completion of student activity 2.6, 3.7 of session 2.7a and club session mentioned in 2.7h.
7	3D Printers (4 units)	Essential for the completion of student 1.5, 1.7, 2.5, 2.11, 2.12, 2.13, 3.3, 3.4, 3.11, 3.13 of session 2.7a and club session mentioned in 2.7h.
8	ONE Laser Cutter including peripheral coolers and fume extractor	Essential for the completion of student 1.5, 2.5, 2.11, 2.12, 2.13, 3.3, 3.4, 3.11, 3.13 of session 2.7a and club session mentioned in 2.7h.
9	TWO Moisture Resistant Boxes	Complimentary to store materials for laser cutting.
10	ONE Set of STEM Production Hand Tools	Complimentary to all making activities 1.5, 1.7, 2.5, 2.11, 2.12, 2.13, 3.4, 3.13 of session 2.7a and club session mentioned in 2.7h.
11	THIRTY robots with LED lighting and greyscale sensors	Essential for the completion of student activity 2.8, 2.9, 2.10, 2.13 of session 2.7a, and club session mentioned in 2.7h.
12	TEN SETS of Robotic Arm Kit	For extended activities in the STEM club session to further develop students' makers mindset, engineering skills, coding skills and ICT related knowledge and skills.
13	ONE SET of VR 360 Degrees Camera	Essential for the VR activity learning projects mentioned in 2.7g and club session mentioned in 2.7h.
14	ONE SET of VR Production Software	Essential for the VR activity learning projects mentioned in 2.7g and club session mentioned in 2.7h.
15	ONE SET of VR Hardware System for special control	Essential for the VR activity learning projects mentioned in 2.7g and club session mentioned in 2.7h.
16	ONE Gaming Desktop with dedicated graphics card for VR	Essential for the VR activity learning projects mentioned in 2.7g and club session mentioned in 2.7h.

** The equipment will be properly kept in designated place on the school premises, correctly and safely, as well as operated by well-trained staff. Our school shall comply with the “Safety precautions and guidelines” of School Administration Guide.

f. Construction works, if applicable

- Our School will observe all the rules and regulations on alteration to school premises and has already seeked approval from the respective Regional Education Office before project commencement.

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

Once all equipment of the STEM lab is employed and teachers are well trained to utilize the resources, students from secondary 1 to secondary 3 will have half of their ICT lessons in the STEM lab as mentioned in 2.7a. STEM content would be integrated into the ICT lessons of junior secondary students.

In each term, four lessons from Geography and Chinese History would take place in the STEM room for students to participate in experience learning sessions with Virtual Reality activities. The VR experiential learning would help students to visualize territorial landforms such as tropical rainforests, plate boundaries, coastal transportation of materials, rivers et cetera, to deepen their impression of the said topics. As for Chinese History, the school hopes to implement VR to help students to learn about different cultural heritage and constructs of the ancient Chinese dynasties including the terra-cotta warriors, the great wall, palace architectures and imperial gardens.

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

The school plans to establish a STEM Club as a weekly after-school student activity club for active students who are interested to extend their learning and experiences in STEM related topics. The STEM club would focus on teaching students advanced knowledge in 3D , Robotics, Coding, Rapid Prototyping and Circuitries. Utilizing VR technologies and equipment, club members would be able to produce VR movies.

Students with outstanding abilities would be selected to participate in interschool and international STEM competitions for them to practise their knowledge and skills. It would also be a great opportunity to share the school’s progress on STEM learning with other participating entities. The students will also join visits to local and overseas STEM institutes to broaden their horizons and enlighten them about STEM pathways for life.

2.8 *Budget*

Revised according to the amount approved by QEF.

Budget Categories*	Breakdown for the budget items: Item	Breakdown for the budget items: Amount (HK$)	Justifications *(Please provide justification for each budget item, including the qualifications and experiences required of the hired personnel.)*
a. Staff	Not Applicable		
b. Service	1. THIRTY-FOUR HOURS of Training cost of teachers' professional development as described in 2.7b. @ $880 per hour.	$29,920	Essential for teaching staff to be able to learn the technologies and ways of teaching with the new STEM materials.
	2. Three Years of Onsite support and consultation services	$45,000	Regular site visits to the school to provide the following support services, including: • Create teaching aids and provide technical support • Assist teachers in writing learning and teaching resources • Arrange planning activities and paperwork
c. Equipment	1. ONE SET of Pro Library Electronic Building Blocks and Logic Gates Bundle	$49,900	Please see 2.7e Equipment
	2. EIGHT SETS of Workshop set Electronic Building Blocks	$130,400	
	3. Electronic Building Blocks (50 units)	$28,500	
	4. ONE SET of Professional high-precision 3D Scanner	$26,000	
	5. ONE SET of STEM Sensors supplementary for Projects Light/Sound/Temperature/Motion, Waterproof Temperature…etc)	$25,000	
	6. TWELVE SETS of Advanced Kit for STEM projects	$26,280	
	7. 3D Printers (4 units)	$80,000	Please see 2.7e Equipment. The hired personnel should ensure that the 3D printers and laser cutter should be properly kept in designated place on the school premises, correctly and safely, as well as operated by well-trained staff. Our school shall comply with the "Safety precautions and guidelines" of School Administration Guide.
	8. ONE Laser Cutters including peripheral coolers and fume extractor	$60,000	
	9. TWO Moisture Resistant Boxes	$8,000	Please see 2.7e Equipment
	10. ONE SET of STEM Production Hand Tools	$5,000	
	11. THIRTY robots with LED lighting and greyscale sensors	$24,000	
	12. TEN SETS of Robotic Arm Kit	$21,000	
	13. ONE SET of VR 360 Degrees Camera	$4,500	

	14. ONE SET of VR Production Software	$25,000	
	15. ONE SET of VR Hardware System for special control	$8,065	
	16. ONE Gaming Desktop with dedicated graphics card for VR	$15,000	
d. Works	Not Applicable		
e. General expenses	1. Plastic Filaments for 3D Printing Projects	$3,000	To produce students' work in class, club time and exhibitions.
	2. Acrylic Boards and plywood boards for Laser Cutting Projects	$3,000	To produce students' work in class, club time and exhibitions.
	3. Crafts materials	$2,000	To produce students' work in class, club time and exhibitions.
	4. Auditing expenses	$5,000	
f. Contingency	(b+c+e)*0.03	$18,735	
	Total Grant Sought (HK$):	**$643,300**	

* ,

(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.

(iv) The school understands that it has to bear the expenses / consequences caused by the relevant school building improvement / reconstruction works, including but not limited to the relevant funding and maintenance work.

(v) The school understands that the funding of the Quality Education Fund is a one-off, and the applicant school must bear future expenses, including maintenance costs, daily operating costs and other possible expenses / consequences.

(vi) The school shall ensure that all goods (including equipment) and services are purchased in an open, fair and competitive manner and shall take measures to avoid any conflict of interests in the procurement process.

(vii) The school shall observe all the rules and regulations on alteration to school premises (including structural alteration and conversion, change of room) and seek approval from the respective Regional Education Office before the project begins.

3 Expected Project Outcomes

3.1 Deliverables / outcomes

☑Learning and teaching materials ☑Resource package

☐~~e-deliverables*(please specify)~~ ________________________________

☑Others *(please specify)* ____

- After school STEM activities, STEM day and resources and materials of teachers' training.
- Students' work
- Electronic copies of teaching materials would be uploaded to the HKEdCity website for the public to browse and download.

**For e-deliverables to be hosted on HKEdCity, please liaise with HKEdCity at 2624 1000.*

** We confirm that the copyrights of the deliverables should be vested with the QEF. Any reproduction, adaptation, distribution, dissemination or making available of the deliverables to the public by the service provider(s) for commercial purposes is strictly prohibited.*

3.2 Positive impact on quality education/ the school's development

By employing new equipment, developing the curriculum and training teachers, the school should be able to develop STEM education in a sustainable and systematic way with hopes of nurturing students into learners of the 21st century.

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)

A thorough evaluation would be done to review the progress and performance of students' learning and of our staff's teaching. It would be done by class observation, surveys, focus groups and review of students' work and performance in STEM related subjects. The investigation should follow the basic principles of research methods and design. Questions should not be biased or leading, and each interviewed party should be truthful and honest during the process of investigation. A pretest and a post test would be given before beginning the term and after the term to evaluate the changes in KSAO development of students and teachers. The school would assess these criteria to measure the success of the programme:

1. The effectiveness of promoting STEM teaching and learning.
2. The positive changes of students' motivation to learn STEM related subjects and knowledge.
3. The improvement of students' creativity, collaboration and problem-solving skills.
4. Development of teachers' professional abilities.

****

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

3.4 Sustainability of the project

The school will organize a proper evaluation and appraisal meeting to review the scheme with the organizing committee and participating teachers. From the discussion, the programme would be improved and extended into new topics of STEM teaching.

After completion, the school would set budget for the maintenance of all STEM equipment employed in this programme so that these fixed assets could be used to aid the teaching and learning processes and improve such experiences. Ongoing professional development related to STEM education will be carried out to ensure that STEM education will continue to be promoted in a sustainable and effective way.

3.5 Dissemination

We would co-organize workshops and seminars with local community organizations to promote STEM teaching and learning, and to share our experience from the projects. We shall invite primary schools and kindergarten students to these workshops to experience the fruit of STEM education.

At the end of each academic year, the school would organize a STEM Fair to display projects and work completed by our students for the local community.

Teachers trained and equipped with new STEM skills will share their experience with other schools to help the academia to develop STEM teaching and learning.

4. Asset utilization plan

Category	Descriptions	QTY	Total Amount (HKD)	Proposed deployment plan
Equipment	Electronic Building Blocks and Logic Gates Bundle	1 set	49,900	After the plan is completed, the relevant equipment will continue to be used at school for lessons and after school activities.
	Workshop set Electronic Building Blocks	8 sets	130,400	
	Electronic Building Blocks (50 units)	50 sets	28,500	
	Professional high-precision 3D Scanner	1 set	26,000	
	STEM Sensors supplementary for Projects Light/Sound/Temperature/Motion, Waterproof Temperature…etc)	1 set	25,000	
	Advanced Kit for STEM projects	12 sets	26,280	
	3D Printers	4 sets	80,000	
	Laser Cutter including peripheral coolers and fume extractor	1 set	60,000	
	Moisture Resistant Box	2 sets	8,000	
	STEM Production Hand Tools	1 set	5,000	
	Robots with lighting and greyscale sensors	30 sets	24,000	
	Robotic Arm Kit	10 sets	21,000	
	VR 360 Degrees Camera	1 set	4,500	
	VR Production Software	1 set	25,000	
	VR Hardware System for special control	1 set	8,065	
	Gaming Desktop with dedicated graphics card for VR	1 set	15,000	

5. Report Submission Schedule

Our school will submit proper reports to the Quality Education Fund Secretariat in strict accordance with the report submission schedule below:

Project Management		**Financial Management**	
Report Type and Covering Period	**Report Due Date**	**Report Type and Covering Period**	**Report Due Date**
Progress Report 01/06/2020 - 30/11/2020	31/12/2020	Interim Financial Report 01/06/2020 - 30/11/2020	31/12/2020
Progress Report 01/12/2020 - 31/05/2021	30/06/2021	Interim Financial Report 01/12/2020 - 31/05/2021	30/06/2021
Progress Report 01/06/2021 - 30/11/2021	31/12/2021	Interim Financial Report 01/06/2021 - 30/11/2021	31/12/2021
Progress Report 01/12/2021 - 31/05/2022	30/06/2022	Interim Financial Report 01/12/2021 - 31/05/2022	30/06/2022
Progress Report 01/06/2022 - 30/11/2022	31/12/2022	Interim Financial Report 01/06/2022 - 30/11/2022	31/12/2022
Final Report 01/06/2020 - 30/04/2023	31/07/2023	Final Financial Report 01/12/2022 - 30/04/2023	31/07/2023