(Revised)

Quality Education Fund
Application with Grant Sought Not Exceeding $150,000
Part B: Project Proposal

Project Title	Project Number
Does Sports and Physical Activity Participation Affect Academic Performance in Hong Kong Secondary School Students? A Longitudinal Study	2014/0774

Basic Information

Name of School / Organisation / Individual

Project Leader: Professor Stanley Sai-chuen HUI

Department of Sports Science & Physical Education, The Chinese University of Hong Kong

Beneficiaries

(a) Sector: ☐ Kindergarten ☐ Primary ☑ Secondary ☐ Special *(Please tick)*

(b) Students: 879 (in number)*[1] and Form 3[#] (class level/~~age~~)*

(c) Teachers: 31 – 40 (in number)*[2]

(d) Parents:_____(in number)

(e) Participating Schools (excluding applicant school): 16 secondary schools (in number and types)

(f) Others (please specify): _____

Remark: using Form 3 students as target populations, this study will identify association between sports/physical activity participation and academic achievement, which will serve as important reference for all teachers, parents, school administrators, and policy makers in Hong Kong.

*[1] 1 to 2 Form-3 classes in each school x 16 schools

*[2] 1 to 2 physical education teachers in each school x 16 schools

Proposal

(I) Project Needs

(a) Please state the aims of the project in clear and concise terms and elaborate how the proposed project could impact on school development.
(Example: To enhance students' interests in reading through story-telling, singing, and drama...)

Most parents and educators opined that sports/physical activity participation hinder academic performance. Hence students are discouraged to engage in sports/physical activity throughout their academic life and subsequently their physical health is greatly harmed. However, such perception is lack of scientific justification.

The project aims to investigate the influence of sports and physical activity participation on secondary school students' academic performance using longitudinal approach. Changes in physical fitness will also be assessed as a secondary measure. The outcome is of particular importance to verify the role of physical activity (PA) in students, especially for two reasons: 1) School is an important place for distributing the message about active lifestyle and to offer PA opportunities for students; 2) Deterioration in

physical health and fitness level in students persistently exists.

Active PA participation is generally thought to affect the academic performance of students. Such beliefs accords with zero-sum theory (Coleman, 1961), which states that the time resource is fixed and that PA is conducted at the expense of study time. As a result, academic outcome is negatively affected. School officials commonly view PA as an energy-drainer that distracts students from concentrating on their studies (Yu et al., 2006). However, this common myth has not been verified, especially with respect to the Chinese population.

According to evidence based research, adolescents are currently recommended to have 60 minutes of moderate-to-vigorous physical activity (MVPA) per day. In light of this scientific project, students will benefit from a more balanced structure between habitual PA and study. Extra PE class, sports-type extra-curricular activity, and active learning lessons can be considered.

This project will be the first study of justifying the effect of sports/PA participation on academic achievement, particularly languages and mathematics, among Form 3 students in a longitudinal setting.

(b) (i) What are the areas of the needs and priorities of the school?
(Please tick the appropriate box(es).)

☑ Enhance learning and teaching to facilitate students' knowledge on subjects / learning areas / generic skills development
☐ Promote students' social and emotional development
☐ Enhance school management / leadership and teachers' professional development / wellness
☑ Others (please specify) improve students' health and fitness

(ii) Please give background information to justify the demonstrated needs as mentioned in (b)(i).
(Please tick the appropriate box(es).)

☐ School development plan: _____
☐ Survey findings: _____
☑ Literature review summary: WHO (1997) reported that good health is essential for effective learning. To achieve good health, regular sports/PA participation is a must. The relationship between sports/PA level and academic performance is enthusiastically studied in western countries recently. However, the findings were not conclusive due to different research designs and methodologies. Little evidence was found in the Chinese population.

It is intuitively believed, especially among parents and teachers, that the time sacrificed for PA participation may induce negative impact on academic performance. Hong Kong is a highly developed city where government attempts to make it a knowledge-based economy which is characterized with greater dependence on information, knowledge, high value-added production, and advanced technology and skills (Census and Statistics Department, 2013; Tsang, 2009), the pressure of competitive education dominates the expectations of individual school and stakeholders (Ho & Kang, 1984), and academic success is often emphasized. Hence, the school experience and learning process is heavily achievement-oriented (Chang & Chen, 2011). Although parents agree that sports/PA participation benefits health (Kimiecik & Horn, 1998; Trost et al., 2003; Ha et al., 2010), parents and teachers are concerned about the negative effect of increased sports/PA time on the academic performance of students (Trost, 2007).

Physical education, which is one of the key-learning areas, only occupies limited school time. Hong Kong adolescents having 30 minutes of MVPA a day for 3 days per week shifted from 48.6% in 2009 to 42.1% in 2011 (Hui et al., 2011). Without definite justification of the relationship between academic performance and PA level, it is difficult to verify the common myth. Therefore, the first step is to establish a solid framework for

investigation in secondary school students. Compared with cross-sectional studies, this proposed longitudinal project will evaluate the effect of sports/PA participation on academic achievement.

- ☐ Assessments on students' performance: _____
- ☐ Relevant experiences: 18years of research experience, 7 large-scaled PA/fitness surveys (e.g. Healthy Exercise for All Campaign: Physical Fitness Test for the Community 2005; 2010; The Asia-Fit Study: Cross-cultural Comparison on Physical Fitness, Physical Activity and Obesity of Youth Among Major Cities in Southeast Asia), 14 government consultancy projects (e.g. Consultancy Study on Sports for All - Participation Pattern of Physical Activity in Hong Kong; Provision of Consultancy Services for The Physical Fitness Requirements for Police Recruitment HKSAR)
- ☐ Others (please specify) _____

(c) Please elaborate the innovative ideas or new practices to enhance, adapt, complement and/or supplement the existing practices that will facilitate the development of the school to address the needs specific to its own context.
(Example: Drama and music are effective means to stimulate students' interest in reading and help develop their multiple-intelligences...)

According to the review on the recent 49 studies, we could not derive a clear causal relationship between academic performance, sports/PA level and physical fitness, with sufficient generalizability. Only 4 local studies had attempted to investigate the relationship among local students (Lau et al., 2004; Lindner, 2002; 1999; Yu et al, 2006). However, these studies were all cross-sectional and correlational. In order to examine the impact of sports/PA participation on academic achievement, longitudinal study is needed. Other than academic performance, other important outcomes from sports/PA participation, such as physical fitness, were not evaluated except the Lau et al. (2004) study. Therefore, we propose to examine the longitudinal effect of sports/PA participation on academic performance and physical fitness.

To fill up the gap in the existing literature, key features of this project include:

1) a shift of methodology from cross-sectional design to longitudinal design;
2) recruitment of representable samples through random selection of secondary schools based on the distribution of student allocation by districts (Education Bureau, 2014);
3) evaluation of sports/PA participation using both indirect PA (questionnaires) and direct PA (movement sensor) assessments;
4) assessment of health-related physical fitness tests as secondary outcome measure; and
5) development of standardized academic achievement tests (pre & post over an entire academic year) that contain content validity for examining academic performance of secondary students across schools (16 schools) using the same standard of measures.

(II) Project Feasibility

(a) Please describe the design of the project, including:

(i) Approach/Design/Activity
(Example: The project adopts the drama-in-education strategy and uses popular children songs to arouse students' interest in reading in a fun and interactive way...)

The project will be carried out in longitudinal mode with two measurement time points. The data collection will be administrated at the 1st semester (starting point) and at the end of 2nd semester (end point) in Form 3 students. Variables including amount of sports participation, habitual PA level, physical fitness, and academic achievement will be evaluated using validated instruments.

For the measurement of sports participation, simple questions about the sports items and

frequency of participation will be adopted from the Physical Activity Questionnaire for Adolescents (PAQ-A; Kowalski, Crocker, & Donen, 2004; Kowalski, Crocker, & Kowalski, 1997). For habitual PA level, three different approaches, including two subjective PA questionnaires and one objective PA measure, will be utilized for ensuring convergent validity. The 1st PA questionnaire is a single-item PA rating on an 11-point scale (Appendix A), called the CUHK Leisure Time Physical Activity Rating for Children & Youth (PARCY, reliability: $r = 0.83$; validity: $r = 0.25$-0.43; Hui, 2001; Hui et al., 2001; Kong et al., 2010), will be administrated to students. Respondents will be asked to give a PA rating according to an average weekly participation over last year. To enrich the data analysis, a 2nd PA questionnaire adopted from the International Physical Activity Questionnaire (IPAQ, reliability: $\rho = 0.76$; validity: $\rho = 0.30$, $r = 0.34$; Craig et al., 2003; Ekelund et al., 2006; IPAQ Research Committee, 2005) will be used to collect the information about the amount of time spent on MVPA in the past 7-days (Appendix B). For objective PA measurement, a sub-sample (about 10% of recruited samples) will be provided with a waist-borne accelerometer (ActiGraph) for 7 days to objectively measure their free-living energy expenditure.

For the measurement of physical fitness, a 5-item health-related physical fitness assessment, including height and weight (BMI), body composition (%fat), cardiovascular endurance, muscular strength and endurance, and flexibility, will be administered. Body weight and percent body fat will be measured by a bioelectrical impedance analyzer with 4 electrodes. Cardiovascular endurance will be assessed from the number of laps completed in a 15-meter PACER test (Progressive Aerobic Capacity Endurance Run). A digital handgrip dynamometer will be used to measure handgrip strength from two arms alternatively. One-minute sit-up test will be implemented to measure abdominal endurance. Modified back-saver sit-and-reach test will be arranged for evaluating student's flexibility at low back and hamstring. Trained and certified fitness testers will be recruited for conducting the fitness assessment in a 70-minute PE lesson. Standardized demonstration and instructions will be provided by trained fitness testers. Students will be given sufficient time to do warm-up and stretching exercise.

For the measurement of academic achievement, the test protocol has to be standardized since more than one school is involved. Participants will be invited to complete a 1-hour standardized academic proficiency test (including Chinese, English, and mathematics) in form of multiple choice questions. The standardized test is a tailored made academic test specifically designed for Form 3 students. School experts (with relevant subject knowledge) were recruited to design question items of the academic test. Two versions of academic tests were produced, one for completion at the beginning of this study and the other one was designed for completion at end of the Form 3 year. Both versions of standardized academic tests had undergone content validity checking following standardized research procedures.

Given the definition of Cohen's d $[(\mu_1-\mu_2)/\sigma]$ (Cohen, 1988) and the recent similar research findings in foreign countries (Bartholomew & Jowers, 2011; Coe et al., 2006; Davis et al., 2011; Hsiao, 2010; Reed et al., 2010), the effect size mainly was found to be at low level. With effect size at 0.2, alpha at 0.05, power at 0.8, and 2 time-points, the estimated sample size is $\{2(z_\alpha+z_\beta)^2[1+(n-1)\rho]/[n((\mu_1-\mu_2)/\sigma)^2]\}\times 2=\{2(1.96+0.842)^2\times[1+(2-1)\times 0.5]/[2(0.2)^2]\}\times 2 \approx 589$ (Hedeker, Gibbons, & Waternaux, 1999). In order to account for attrition, 5% of this sample size will be added on, i.e. a minimum of 618 participants will be included.

To assure the representativeness of the study to certain degree, sixteen secondary schools (see a list in Appendix C) are invited to participate in the study based on the distribution of student enrollment (Education Bureau, 2014). Three districts are considered. Two Form-3 classes of about 30 students will be selected from each school. A total of 879 adolescents who do not have known cardiovascular and pulmonary diseases, neurological disorder, or musculo-skeletal disorders will be recruited.

Research Ethics was approved by the Ethical Committee of CUHK. Safety Guidelines on PE KLA for the Hong Kong Schools (2011) will be observed.

Statistically Analysis: In order to answer the research question, the IBM Statistical Package for Social Science (SPSS) version 20.0 will be used for data analysis. The changes in academic performance of an academic year will be correlated with the level of sports/PA participation using Pearson correlations. Students will be categorized depending on their PA level and fitness performance. One-way ANCOVA will be used to detect any significant difference in academic performance between various PA levels and fitness groups given family monthly income as a covariate. Pairwise comparison will be conducted as a post hoc procedure if significant effects are defected. Two-way repeated measures ANCOVA will be executed to identify if sports/PA participation and physical fitness have any interaction effect on academic performance. Stepwise regression will be applied to determine the predictive values of sports/PA level and physical fitness on academic performance. Logistics regression will help to examine the odds ratios of having better (worse) academic score from comparing sports/PA level and fitness levels between the high-end and the low-end groups. The significant level is set at $p \leq 0.05$.

(ii) Key Implementation Details

Project period: 2 / 2016 to 12 / 2016

Month / Year	Content / Activity / Event	Target Beneficiary/ Participants
9 – 11 / 2015 (preparation period)	Recruitment of Schools	16 schools *[4] have been finally recruited
11 – 12 / 2015 (preparation period)	Recruitment of physical fitness testers and sampled students (preparation)	------
12 / 2015 – 1 / 2016 (preparation period)	Preparation of equipment and document for the 1st data collection stage	------
2 / 2016	1st measurement of academic performance, fitness, and sports/ PA level (baseline)	879 students
4 - 5 / 2016	Data processing of baseline data	------
5 – 6 / 2016	Updating participated schools the current progress	16 school representatives
6 – 7 / 2016	2nd measurement of academic performance, fitness, and sports/ PA level (end-point)	879 students
7 / 2016	Teachers' seminar *[5]	30 PE teachers
8 – 9 / 2016	Data processing of phase-two data	------
10 / 2016	Data analysis and report write-up	------
11 – 12 / 2016	Fact sheet production and dissemination; Results dissemination via website & press	Schools, Teachers, General public

*[4] At least one individual briefing session will be arranged for PE teachers from each school. Related fitness testing batteries and recent literature on the association between PA participation and academic achievement will be introduced to them.

*[5] Proposed topic of the seminar : updated physical fitness tests in school setting

(b) Please explain the extent of teachers' and/or principal's involvement and their roles in the project.

(i) Number of teachers involved and degree of input (time, types, etc.):
15 experienced teachers are invited to be expert reviewers for validity checking of academic proficiency test papers. More than 40 PE teachers and school officials are closely collaborating with our project team throughout the data collection period. They will also monitor 5-hour class time and provide appropriate venues for resting measurement and exercise testing.

(ii) Roles of teachers in the project: (*Please tick the appropriate box(es).*)

☑ Leader ☑ Co-ordinator

☐ Developer ☐ Service recipient

☐ Others (please specify)_____

(c) Please provide the budget of the project and justify the major items involved.

Grant Sought: HK$ 150,000

Budget Item*	**Expenditure Detail**		**Justifications**
	Item	**Amount ($)**	
i) Staff	Part-time Research Assistant	21,483	2 months, at pt 11 of CU pay scale at 50% x 2 months (22 hours per week) (MPF inclusive) ($21,483 x 50% x 2 months) The R.A will help coordinating schools and recruiting fitness testers for data collection. The R.A will also assist in data input and management.
ii) Service	Fitness assessments by qualified fitness testers	96,096	$143/man-hour x 336 man-hours/ phase x 2 phases (pre- & post-) =$96,096 (Trained fitness testers are needed for conducting fitness tests in P.E. classes in order to ensure valid, and good quality data collection)
~~iii) Equipment~~			
~~iv) Works~~			
v) General expenses	Printing, postage, consumable stationery for fitness testing & logistics, transportation	7,800	Printing of invitation letters, questionnaires, test papers, data record sheet, and reports; postage of invitation letters and fact sheets; purchase of consumable stationery for fitness testing; delivery of fitness testing equipment .
	Audit Fee	5,000	
	15% administrative cost	19,557	Charged by the CUHK for utilization of university facilities (e.g. office space, equipment, & facilities, electricity and water supplies), and administrative services (such as personnel and accounting services), etc

~~vi) Contingency~~			
Total Grant Sought ($):		149,936 (150,000) (round to hundred)	

(III) Expected Project Outcomes

(i) Please describe how to evaluate the effectiveness of the project;
(*Please tick the appropriate box(es).*)

☐ Observation: _____
☐ Focused group interviews: _____
☑ Pre-and post-activity surveys:
Physical fitness performance, sports/PA participation, and academic achievement
☑ Performance change of students in assessment:
Physical fitness performance, and academic achievement
☑ Others (please specify)
With reference to the literature, comparison of the evidence-based findings according to the statistical results from Pearson correlation, Spearman correlation, analysis of covariance, stepwise regression, and odds ratio at $p \leq 0.05$

(ii) Please state the project deliverables or outcomes.
(*Please tick the appropriate box(es).*)
☐ Learning and teaching materials
☐ Resource package
☐ DVD
☑ Others (please specify)
1) Report of physical fitness performance and prevalence of physically active students to schools and participants;
2) Press release and fact sheets on the longitudinal findings of what extent students' sports/PA participation, fitness level, and academic performance are related.

Asset Usage Plan – Not Applicable to this project

Report Submission Schedule:

The grantee commits to submit proper reports in strict accordance with the following schedule:

Project Management		Financial Report	
Type of Report and Covering Period	Report Due Date	Type of Report and Covering Period	Report Due Date
Final Report 1/02/2016-31/12/2016	31/03/2017	Final Financial Report 1/02/2016-31/12/2016	31/03/2017

Appendix A

CUHK Leisure Time Physical Activity Ratings for Children & Youth

From a scale of 0 to 10 listed below, that ***best describe your overall weekly level of physical activity in the past 12 MONTHS period****, then put the number in the square provided below (refer to the annex table* below for descriptions of light, moderate, and vigorous activities):*

Select ONLY ONE (0-10) rating and put into this square: ☐

Choose 0 to 2 if you have **no exercise habits at all**

0 – **No** physical activity at all, spend most of your time sitting or sleeping
1 – **No** physical activity **EXCEPT little physical activity** during **PE** lessons.
2 – **No** physical activity **EXCEPT** being **active** during **PE** lessons.

Choose 3 to 6 if you, in addition to activity during PE lessons, participate in other physical activity **occasionally**

3 – **Besides of PE** classes, I participate in **light** activities (3METs)# last longer than 20 minutes only **once or twice** a week.
4 – **Besides of PE** classes, I participate in **light** activities last longer than 20 minutes for **three times** a week.
5 – **Besides of PE** classes, I participate in **light** activities last longer than 20 minutes **almost every day**.
6 – **Besides of PE** classes, I participate in **moderate** activities (5METs)# last longer than 20 minutes only **once or twice** a week.

Choose 7 to 10 if you, in addition to activity during PE lessons, participate in other physical activity **regularly**

7 – **Besides of PE** classes, I participate in **moderate** activities last longer than 20 minutes for **three** times a week.
8 – **Besides of PE** classes, I participate in **moderate** activities last longer than 20 minutes **almost every day**.
9 – **Besides of PE** classes, I participate in **vigorous** activities (9METs)# last longer than 20 minutes **three times or less** weekly.
10 – **Besides of PE** classes, I participate in **vigorous** activities last longer than 20 minutes **almost every day**.

*Annex Table: **Examples** of Light, Moderate, and Vigorous Activities

	Light (3METs) #	Moderate (5METs) #	Vigorous (9METs) #
Home Activities	Walk around home; Handle household appliances	Walk upstairs while lifting a 1-15 lbs weight; Walk stairs up and down	Carrying heavy groceries upstairs
	Walk downstairs	Home exercise e.g. calisthenics, sit-up	Vigorous activities e.g. push up
	Light playing while standing	Floor cleaning by hand	Moving large furniture upstairs
	Household cleaning e.g. mopping floor, vacuuming	Window or car washing which requires heavy physical exertion	
Sports Activities	Playing bowling	Cycling; Playground playing	Cross-country running/ skiing
	Volleyball playing (1 ball for 6-9 persons)	Mixture of slow jogging & fast walking; Game playing inside water	Vigorous basketball/ soccer competition
	Archery	Basketball shooting (continuous)	Lap swimming
	Frisbee	Badminton playing (single or double)	Orienteering
	Dancing in a dance room (slow dance, waltz)	Low impact aerobic dance & folk dance	Fast running: 8.4 km/h or 7.1min/km (5.2mph or 11.5min/mile)
Others	Guitar playing (standing)		
	Band marching		

METs is Metabolic Equivalent; 1 MET is the energy expenditure during rest; 3 METs is three times the energy expenditure of resting; 6 METs is six times, and so on.

Appendix B

International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.