Title :

Promoting Independent Enquiry learning skills in the New Senior Secondary curriculum (NSS) through Satellite Remote Sensing and Geo-information Science

I. Overview/ Background

a) **Launching of the New Senior Secondary curriculum (NSS) in 2009**

The New Senior Secondary (NSS) curriculum will be implemented in 2009. To enhance teachers' readiness for this initiative, this project will help teachers better understand and be equipped with the necessary methodology and technology to successfully guide their students to acquire Independent Enquiry Learning skills.

Satellite Remote Sensing (RS) and Geo-information science can be effectively apply to NSS curriculum particularly in students' independent enquiry learning relating to subjects such as Geography and Liberal Studies.

b) **Rationale of the Project**

One important aim of education reform is to prepare students to meet the challenges in the **future world** which require a diverse set of skills including a **global point of view, independent thinking** and the ability to cope with **sophisticated technology**.

i. Geo-technology is one of the crucial skills in the future world.

Nature Magazine (Vol. 427, 2004), identified **geo-technology** (i.e. Geographical Information System - GIS and **Satellite Remote Sensing**) as one of the three most important emerging and evolving technologies in the future world, together with **nanotechnology** and **bio-chemistry**. According to the National Space Programme, China will launch more than 20 remote sensing satellites in the next 10 years. Together with other remote sensing satellite that have been, or will be launched, an increasing amount of available data, using satellite remote sensing and Geographical Information System (RS&GIS) data, these will have an important effect on our daily life in future. Pedagogically, teachers should equip students to have new concepts by which students can extract information from remote sensing data and be better prepared to live in the new era brought about by this evolving technology (US Research Council, 2005).

ii. *RS& GIS* technology enhances global point of view

RS&GIS technology **is a vital tool especially in student projects to deliver a complete picture of issues so as to enhance a global point of view.**

A recent research conducted by US Research Council (NRC) indicated that "spatial thinking" is a way of thinking across most sciences and disciplines. It is estimated that about 80% of the currently available information data are spatially relevant and there will be increasing number of location-based technologies/ services in future. Our students will have more opportunities to come across geospatial technologies in their future workplaces (e.g. making decision using spatial information in disease-spreading control) and daily life (e.g. showing essential driving routes).

Hence, students' global and spatial point of view, as an essential element to the comprehensive understanding of the complex world, should be promoted and applied in the NSS curriculum as a cross-disciplinary generic skill.

iii. *RS&GIS* technology offers an essential platform for independent thinking

RS&GIS provides a platform **for students to integrate information and knowledge among different disciplines and perspectives,** with which students can collect data at different time and latest (e.g. related to occasional event such as earthquake, snow storm in China) satellite images, organize facts from different points of view (e.g. cultural, political, economic etc.), make connections among the information on the digital map, combine with other sources of related knowledge / information and construct their personal knowledge. Finally, students can present their findings in the form of map presentation.

iv. To prepare Hong Kong students acquire the ability to cope with sophisticated technology

Nowadays, many European and American countries have effectively integrated remote sensing technology to their secondary school curriculum.

The National Aeronautics and Space Administration (NASA) sponsor the project: "Classroom of the Future" (www.cotf.edu) and "GLOBE" project (http://www.globe.gov/) that introduces advance space and remote sensing technology into classroom.

European Space Agency (ESA) (http://www.eduspace.esa.int/) developed the "EDUSPACE" that provides satellite images teaching recourses for secondary schools.

Germany (Voss *et. al,* 2007) started a project recently that integrate satellite remote sensing in secondary curriculum, which is interdisciplinary and incorporate the remote sensing technology into different subjects.

Gupta *et. al* (1994) reported that a project of introducing remote sensing from primary to post-graduate levels had been proposed in **India.**

Kirman (1998) reported that Canadian government has developed a teaching-support resources centre for this purpose.

Nevertheless, **teachers in Hong Kong as yet do not have enough support** for promoting such kinds of technology. In practical sense, satellite remote sensing possesses unique opportunities of providing multi-disciplinary teaching supports and integrate knowledge of different subjects such as geography, biology, physics, mathematics and computer sciences (Voss *et. al* 2007). Compared with traditional forms of dataset, satellite images provide more up-to-date data regarding the real-life phenomena covered by various subjects. Moreover, the images provide unique insights into educational topics related to local and global environment and promote concepts of globalization.

In the long run, satellite remote sensing and GIS will be an integrated component of the education system and, like information technology, it will be a cross-disciplinary teaching tool supporting subjects such as liberal studies, sciences, computer sciences, social studies and geography.

Considering the unique nature of Geography and Liberal Studies, the Project Team proposes to introduce satellite remote sensing technology initially to these two subjects, and then eventually to other subjects (these will be elaborated in more detail in "needs of the project"). Although the proposed Project initially focuses on the above two subjects, the project deliverables (e.g. the satellite image teaching resource library, image analysis software, teachers being equipped with the professional skill) could also benefit students of other subjects (e.g. Integrated Sciences, Physics, Tourism and Hospitality Studies, Information and Communication Technology etc.) and leave rooms for future expansion of developing satellite remote sensing as a multi-disciplinary teaching tool.

c) Why RS&GIS technology are important to enhance the quality of the Independent Enquiry learning experience

Good source of information.

RS&GIS data has the following unique nature that helps students' project:

i. Satellite Remote Sensing is a unique technology that provides comprehensive near real-time data on the Earth's surface for a large area (~ 100km X 100km);
ii. The CUHK Project Team can provide timely Satellite Remote Sensing Image correspond to the occasional phenomena (e.g. Earthquake, snow crisis in China) occurring on the Earth everyday.
iii. Remote Sensing Data are not restricted by political boundaries, students / teachers can easily access remote sensing images of any interested phenomena, anywhere in the world.
iv. As a kind of space technology, students will be motivated by the "high-tech" tools which will increase their interest in learning.
v. Both students and teachers can use the first hand and updated data for investigating earth surface phenomena, which is an excellent way to facilitate students' project.

Integrate different points of view and facilitate higher order thinking

RS&GIS enables students to see information that is not accessible via conventional sources (e.g. textbooks, maps, encyclopedias, etc). The information from RS&GIS can also be readily overlaid over each other to reveal potential relationships. As such, information that relates to different points of view can be integrated together using RS&GIS, students can then conduct an integral analysis and consider views from multiple perspectives.

Global thinking
RS&GIS is a unique technology that organizes spatial data all round the world and presents the data in a meaningful way, they show students the bigger picture and how things are interrelated all over the world.

Spatial thinking
Learning with maps and working within a geographical scale allows students to learn to identify patterns and spatial relationships among data related to different area studies (e.g. public health, population, transportation, cultural characteristics etc.). Such thinking skill is cross-disciplinary and helps student connecting knowledge from different subjects (US Research Council, 2005).

Inspiring critical thinking from diverse sources of data
Having access to many types of data allows students to explore different hypothesis and come up with original analysis and conclusions. Instead of receiving pre-prepared information from static textbook, students are able to discover new facts and even knowledge thought self-directed exploration of data in RS&GIS and offers an entire new learning experience for the students. Such skills would be important for the student throughout their studies as well as future careers.

d) Teacher's practical difficulties to lead student projects and how our project can help
In the process of enquiry learning, students are expected to ask critical questions, searching sensible answers from different point of views, and evaluate the decision or conclusion analytically. Frontline teachers find it difficult to inspire students to ask challenging and meaningful questions. They find that students' perspectives are limited to their textbook knowledge and they are not aware of what other newly introduced tools they can use to obtain more current and relevant information.

RS&GIS is a unique technology providing strong visual impacts to the students on the spatial patterns and relationships between different points of views. In particular, the US Research Council suggested spatial information can stimulate students to ask the following questions:

- What is at ....?
- Where is ...?
- What are the related spatial data and what are their relationships?
- What and why spatial pattern exists?
- What if ...?

As such, RS&GIS technology not only opens up a new world of information that is both timely and highly customizable to their topic of interest, the technology also suggests a systematic, cross- disciplinary approach to apply the knowledge / skills to an interested enquiry. In particular, RS&GIS helps every stage in implementing student projects in each stage, students can be inspired to ask different levels of questions, examples can be found in Annex 1,

Our project team members will go to the schools for collegial lesson planning and help frontline teachers to make use of RS&GIS data, integrate the curriculum and apply independent enquiry skills and finally, suggest a practical solution of RS&GIS for implementation of IES and SBA student projects and application of independent enquiry skills.

e) Build on the success and fill the gaps

The Project Team understands that there is an on-going effort of introducing GIS in learning and teaching of geography. The proposed project aims to supplement current scenario by introducing geographic information science to support **Independent Enquiry Learning of Geography and Liberal Studies.**

Listed below are details of areas in which our project can build on the success and supplement the possible gaps.

	Current scenario of using GIS in Learning and Teaching	Possible gaps for improvement	Unique Characteristic of the Project
Beneficiaries	Geography teachers and students	In the future world, this is a crucial skill that every student should have.	The project aims to help students to improve and enrich the independent enquiry learning skills which is generic and can be applied to any NSS curriculum. Therefore, **ALL NSS students and teachers** will be benefit from this project.
Nature of data	GIS data is relatively retrospective, with which data can be updated only once a year or once per several years.	Cannot reflect unpredicted events.	The project use current satellite remote sensing data and supplement with GIS data of Hong Kong and PRD regions. Satellite image can provide the **"near real time" images**.
Cost of data		Long term cost implications on data	The images received by the Satellite Receiving Station of CUHK will be provided to the participating schools **for free**. CUHK will cover the cost for those data.
Software			
User friendliness	The commonly used GIS software packages are complicated and the software is not tailor-made for educational use.	Commercial GIS software package may be too difficult for teachers / students' uses.	Our project team will develop a **user-friendly software** with simple but essential function, which tailor made for Hong Kong students and teachers who are with or without background of using GIS and RS.
		Mainly used by skilled geography teachers	Can be potentially used by **ALL** teachers / students.
License and copyright	Software license of commercial package is owned by the vendor	Difficult to modify the software according to the need of local teachers and students.	Project Team can modify the software to **suit the specific needs** of the frontline teachers / students.
Software cost	Most currently used software incurs initial cost and recurrent annual cost.	Long term cost implications	Provided **for free** to all schools in Hong Kong.

II Objectives

The Project aims to:

a) Introduce innovativeness to:

- raise students' learning motivation and promote self-learning by exposing students to new satellite remote sensing technology,
- develop a global and dynamic view of students through the use of satellite remote sensing technology ,
- encourage students and teachers to make use of new technology for interpreting of real life phenomena, and
- help students and teacher to better understand the world they inhabit by enabling them to interpret and analyze first hand data from satellite images.

b) Support student projects by:

- providing school based support on implementing students' independent project in NSS curriculum,
- enhancing teacher professionalism and maximizing the effectiveness of leading students to conduct student projects,
- mobilizing and network in participating schools for sharing experiences,
- creating opportunities for students to share the student project products,
- developing and providing continuous maintenances for a satellite remote sensing teaching resource centre. The resources centre will provide satellite images and resources and benefit to all teachers and students in Hong Kong, and
- establishing a satellite remote sensing resource centre which provides continuous supply and maintenance of satellite images for the use of all teachers and students in project schools.

III. Implementation of the Project

The duration of the project will last for two years from October 2009 to September, 2011, plus two months preparation from August to September 2009.

To actualize the above goal, the project team has the following implementation plan :
The project will consist of 4 tasks :

Task 1 : Developing and systemizing a **resource pool** of data which includes:

- Latest satellite images covering Hong Kong and Pearl River Delta (PRD)
- Timely satellite images covering occasional emergency events
- The satellite images could be used not only in NSS geography but also in NSS liberal studies and other subjects
- GIS dataset used in the classroom activities by the teachers of the 10 seed schools
- Teaching materials, lesson plans, videos or worksheets shared by schools.

Task 2 : Developing a user-friendly **Software** for RS&GIS data Analysis

- The software is tailor-made for Hong Kong teachers and students, which is easy-to-use and can perform basic functions when students are doing their projects.
- Please refer Annex 2 for Functions and unique features of the software.
- The software for RS&GIS data analysis would be developed solely by the CUHK in-house project team and would not infringe any copyright laws of Hong Kong.
- The project team will run training courses to familiarize teachers to use the software and integrate the

Task 3 : School based support

- The project team will provide occasional on-site support to schools, helping teachers to integrate the RS&GIS data into the existing curriculum so as to enhance enquiry learning.
- Cluster sharing or cluster collegial lesson planning workshops will be organized for the purpose of building a professional learning community.
- After the initial trial, the collaborative lesson planning will put emphasis on how to help students to apply the technology in their independent enquiry learning projects

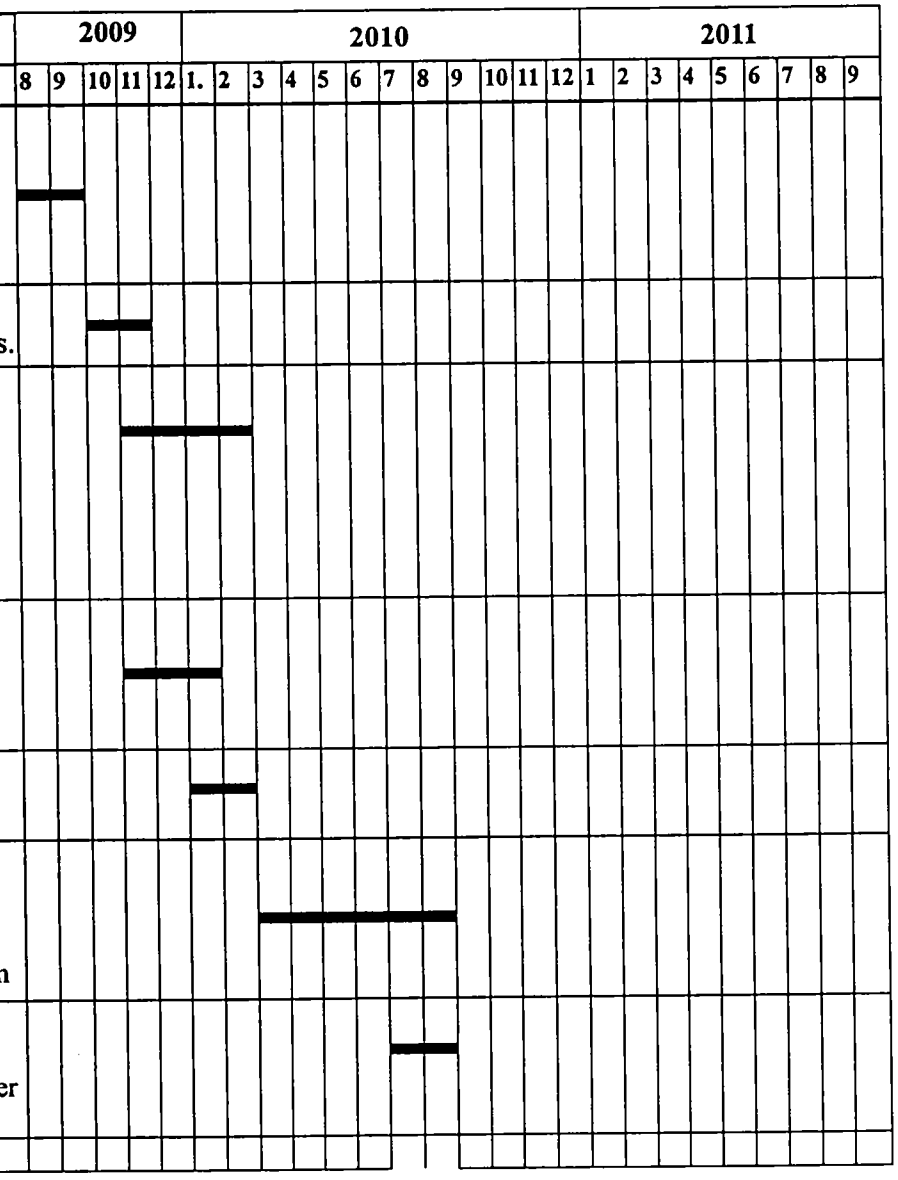
Task 4 : Student project support

- The project team will organize following activities to support teachers to lead the student project:
  - Introductory courses/ workshops for familiarizing students to explore and use the RS&GIS data.
  - Local field trips for practicing the technology and methodology.
  - Student project competition for encouragement of application.
  - On-line exhibition area for sharing of products of student project.

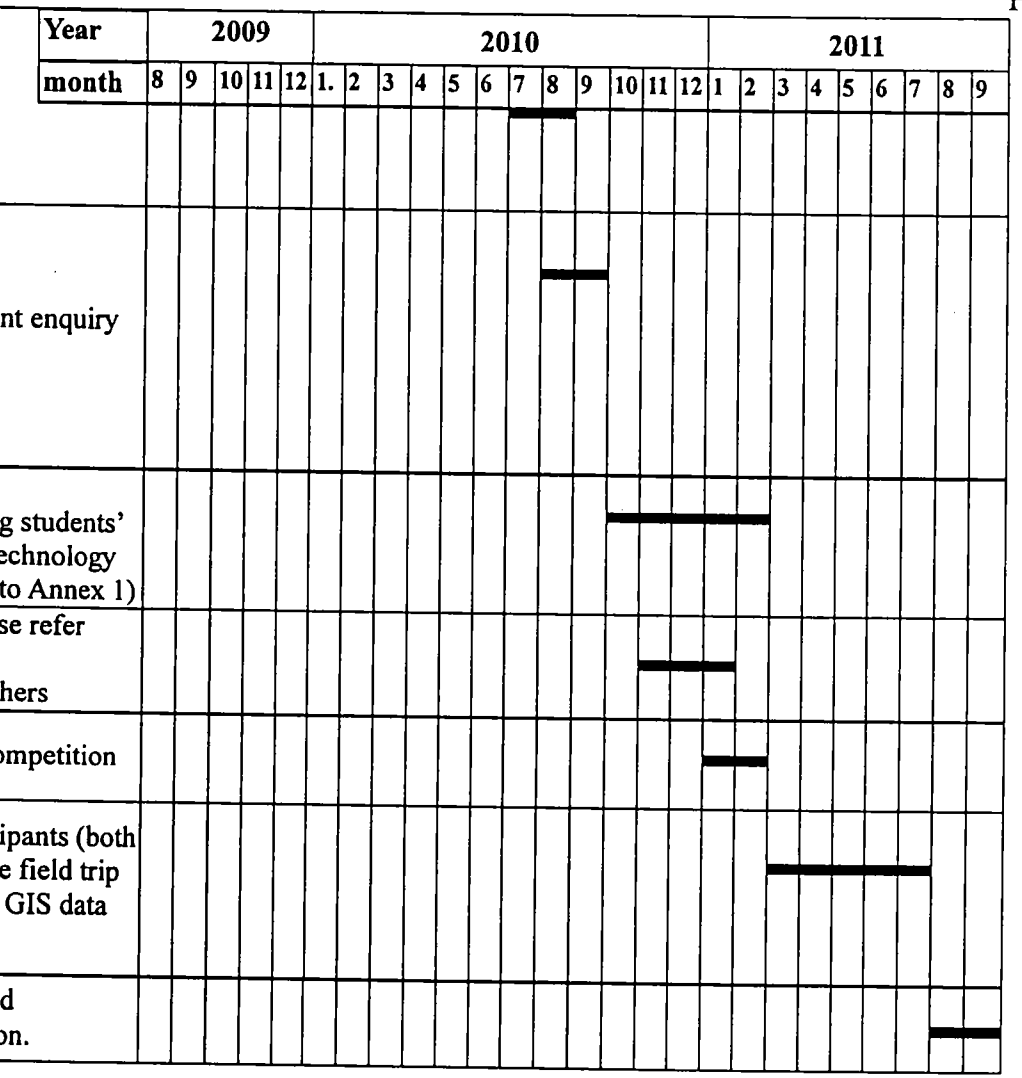
The actual dates of particular tasks are list as follows :

Implementation time frame

Task 1	Task 2	Task 3	Task 4	participants	Action Plan
✓				10 seed schools	Project kick-off Discussion of expected barrier of leading student projects in NSS curriculum Preparation for NSS curriculum to cope with enhancing students' enquiry skills
		✓		10 seed schools	In-depth training for all teachers from 10 seed schools.
		✓		10 seed school	School base support 1st round collegial lesson planning and/or class observation with focus on integrating RS&GIS technology into the curriculum (please refer Annex 3 & 4 for enquiry questions in Geography and L.S. Curriculum)
		✓		Invite all school teachers in HK, about 45 schools participate.	1st round teacher training workshops (please refer Annex 5 for content) 3 workshops, each entertains about 15 teachers
		✓		20 schools	Recruitment for 2nd batch partner schools. Accept 20 schools that show interest from the workshop.
✓				10 seed schools + 20 partner schools	School base support and Networking 2nd round collegial lesson planning and/or class observation with focus on integrating RS&GIS technology and students project skills into curriculum
✓		✓		10 seed schools + 20 partner schools	Experiences sharing : cluster sharing sessions for building professional learning communities among seed schools and partner schools.
		✓		All schools	Recruitment for students project competition



Task 1	Task 2	Task 3	Task 4	participants	Action Plan
				Students who show interests to join the competition and recommended by teachers (about 30 teams).	Students training workshops on Independent enquiry learning skills, and RS&GIS technology.
		✓	✓	10 seed schools + 20 partner schools	3rd round collegial planning : With focus on teachers' guidance of leading students' project and how to make use of RS&GIS technology during the process. (examples please refer to Annex 1)
		✓		Invite all school teachers in HK, about 45 schools	2nd round teacher training workshops (please refer Annex 5 for content) 3 workshops, each entertains about 15 teachers
			✓	All schools	2nd round recruitment for student project competition
			✓	Schools that join the competition.	Professional support for competition participants (both teachers and students) including at least one field trip (for students) on how to integrate GPS and GIS data in the project.
✓		✓	✓	All schools	Experience Sharing, Award presentation and Dissemination of student project competition.



Software and data management

	✓			Basic teaching resources preparation – Web-based remote sensing resources centre development

Task				participants	Action Plan	Year	2009					2010												2011								
1	2	3	4			month	8	9	10	11	12	1.	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
	✓			Development of software for RS&GIS usage (please refer Annex 2 for functions of the software)																												
	✓			Maintenance and supports for the on-line resources centre																												

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IV. Capability and Readiness for Implementing the Project

a) This project will be led by Institute of Space and Earth Information Science (ISEIS), in collaboration with Centre for University and School Partnership (CUSP), Faculty of Education, Chinese University of Hong Kong. Both of which have extensive experience in remote sensing and school support, respectively.

The CUHK Satellite Ground Receiving: Before the Antenna Radom was built (Left); With Antenna Radom (Middle); the Control Room (Right)

- Institute of Space and Earth Information Science, Chinese University of Hong Kong.
  The Team has over twenty-year experience in Remote Sensing and GIS education, researches, application and teaching materials developments. Key strengths of the team include:
  The Project Team is the operator of the **Satellite Ground Receiving Station** and possesses the data ownership of the received satellite images. This enables us to promptly update the teaching materials and distribute satellite images to the participating secondary schools for free.
  The Project Team has completed a QEF Project: Learning Geography from the Space - Introducing Satellite Remote Sensing Technology to the Geography Teaching of Hong Kong (2005/0226) and possesses solid experiences in teaching materials developments and understandings the geography teachers' requirements.

- Collaborating Unit：
  Centre for University and School Partnership (CUSP), Faculty of Education .The Centre for University and School Partnership (CUSP) was established in 1998 with the aim of fostering partnerships amongst the University, schools and other related institutions for the betterment of education in Hong Kong. Since its establishment, the Centre has secured several projects funded by the Quality Education Fund (QEF) and the Education Department (ED) / Education Bureau (EDB) amounting to around HK$130 million and HK$40 million respectively. Projects funded by QEF include the Accelerated Schools for Quality Education (ASPQE), the University & School Partnership for Quality Education (USPQE), the Quality School Project (QSP), Home-school Collaboration and Gifted Education Programs. Those funded by EDB are related to issues of school effectiveness, motivation and individual differences, as well as partnership development amongst the University, schools and the Education Bureau. Recently, the Centre has also embarked on a school-initiated partnership project known as "Partnership for Improvement of Learning and Teaching (PILT)" project, and "Support for Transition to the Implementation and Leadership of Liberal Studies (STILLS)"under the auspice of EDB as well as provided in-service teacher development courses on Project Learning in Personal, Social and Humanities Education.

b) Key members of the Project Team:

Project co-leader: Prof. LIN Hui (林琿教授).

Prof. Lin is the Director of the Institute of Space and Earth Information Science (ISEIS) of CUHK. Prof. LIN is an internationally well-known expert in Remote Sensing and managed multi-million projects funded by ITF, RGC as well as "863" High-Tech Program. Prof. Lin will provide the overall direction to the Project Team.

Project co-leader: Prof. LEE Chi Kin, John (李子建教授).
Prof. John Lee is the Dean of Education of CUHK and is a distinguished researcher in curriculum and instruction theories, school improvement and school-university partnerships and geographical education. Prof. Lee also served as member of the Advisory Committee on School-based Management, Education Department, Council member of Hong Kong Examinations and Assessment Authority as well as member of the CDC-HKEAA Committee on Geography (Senior Secondary). Prof. Lee will provide guidelines to the Project Team on developing the teaching materials especially the advice on NSS-related contents and activities.

V. Deliverables

The following are expected deliverables and outcomes of the Project:

a) Tangible products

i. Collaboration with the 10 trained secondary schools to develop school-based teaching materials and methodology for IES.
ii. Training course for more than 100 secondary schools of Hong Kong. The training will focus on how to how to make the full use of RS&GIS data and to use them in the students IES.
iii. An on-line resource centre which contains regular updated satellite images over Hong Kong and Pearl River Delta (PRD), a discussion forum for the participating teachers, on-line library of school specific teaching materials, exhibition areas of student projects, and announcement of trainings / activities.
iv. Student Projects Competitions to encourage students to apply satellite remote sensing technology to investigate a geographic issue.
v. Seminars to disseminate interim and final project results to the geography teachers of Hong Kong.
vi. Report of the experience gained which consolidates the experiences of incorporating satellite remote sensing to the NSS curriculum and provides recommendations on implementing the technology.

b) Intangible products

School level:	To disseminate good practices in IES and application of independent enquiry skills in NSS curriculum in seminars/ sharing sessions/ conferences/ publications, etc.
	To be able to identify and review foundation knowledge missed in Key Stage III as compared with knowledge needed inn NSS curriculum;
Teacher level:	To have a better understanding of the spirit of independent enquiry skills ~~IES~~ that can be facilitate whole person development and enhance life long learning.
	To enlarge their role of scale for paradigm shift, e.g. more and more teachers will facilitate issue-enquiry learning and adopt interactive pedagogies to provide more time and more opportunities for students' self–learning and development of higher order thinking in the classroom;
	To have more frequent professional sharing of NSS curriculum at school and outside schools than before.
Student level	To enjoy the learning process through the exploration to sophisticated technology and manipulating of real world data.

VI. Beneficiary

Targets and expected number of beneficiaries
Initially, the Project Team will collaborate with 10 seed schools to develop school-base curriculum and have some trial on students' application of independent enquiry skills in their learning projects. After that, the Project Team will enroll 20 more partner schools and develop their school-based curriculum and

teaching plans accordingly. The Project Team will also conduct training courses on utilizing RS&GIS data in the NSS curriculum for about 70 local schools.

Other then the supports to teachers, the Project Team will also organize preparation students workshops participants for ensuring the Student Project Competition. This is expected that around 30 schools will participate and benefit from the workshops.

By the end of the proposed project, direct beneficiaries include: 10 seed schools and 20 partner schools, 70 participating schools received training from the Project Team. That is, a total of 100 schools will benefit from this Project. Besides, the Project Team will invite around 20 student projects, organize workshops and provide essential supports for the teachers and students to carry out their projects.

Our proposed project is an evolving project with increasing participants and richer contents in the on-line resource center as the project goes along. After completion of the project, all the secondary schools of Hong Kong will be the potential users of the program. Eventually, the project will benefit all secondary schools, teachers and students in Hong Kong.

VII. Assessment and monitoring

a) The Project Team specified the following evaluation of the parameters:

Goal	Parameter	Method of evaluation
Raise students' learning motivation	Students have initiative and willing to learn	Class observation Interview from students and teachers
Develop a global and dynamic view among students, better understand of the world	Students view points broadened.	Students' work contents observed from class discussion, homework, projects, etc
Expose students to realize and apply the technology in real life phenomena	Students' performance in the process of enquiry learning activities and project.	Quality of student projects
Professionalism development of the participating teachers	Competence of the participating teachers in developing school-based teaching modules with satellite remote sensing data integrated;	Interview or questionnaire from participating teachers
	Confidence of the participating teachers in using satellite remote sensing in teaching.	Teacher interviews.
	Confidence of teachers to lead student projects	
	Mobilize and network for sharing experiences.	Teachers' feedback on cluster sharing section and dissemination seminar.
Create opportunities for students to share student products	Successfulness of student project competition	Quantity and quality of student project competition.
Image analysis software Development of satellite remote sensing teaching resources centre.	Functionality of images analysis software;	Feedback from teachers and students Frequency of use of the resources centre
	Usefulness of the software	
	Quality of the teaching resources to the remote sensing related topics in the NSS curriculum.	
	Application of materials in the actual classroom environment.	

b) Governance of the Project:

If the project is successfully funded, a steering committee will be set up to advise on the operation of the project. Representatives from relevant sections of education field, the project schools and external members would be invited to join the Steering Committee.

c) Sustainability of the outcomes of the project.

On completion of the proposed project, major teaching resources (i.e., satellite data, image analysis software) applying RS&GIS technology, will have been developed. The Project Team will maintain the on-line resource centre and the teachers' supporting network with the provisions of continuous training courses to local teachers. The Project Team aims to make use of the practical experiences, resources and teacher's network to incorporate the technology to other NSS subjects.

VIII. Budgeting

The costs of the project are as follows:

Staff Costs	HK$4,161,638
Equipment	HK$121,700
General expenses	HK$274,000
Contingency	HK$11,962
Total	HK$4,569,300

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Budget breakdown

a) Staff cost

Rank	Description	Staff cost per month	Establishment (Total man-months)	Amount
Technical Manager (Principal Trainer)	The Technical Manager will take up to key role of designing the deliverables, developing training courses, providing guidance on the implementation and working with other project members to support the partner schools. He / She will also act as the principal training and conduct most of the training course for the participating teachers and students.	HK$34 950 CU NCASS (RAP) Point 1(a) x 26 months = HK$908,700. plus MPF: HK$26,000 = HK$934,700.	1 Professional Consultant (26 man-months/ equivalent)	HK$934,700 (MPF included)
Technical Manager (Software development)	The Technical Manager (Software Development) responsible for the development of the RS&GIS Software. The Technical Manager shall design the overall software architecture, supervise the development team and control the software quality.	HK$34 950 CU NCASS (RAP) Point 1(a) x 24 months = HK$838,800 plus MPF: HK$24,000 = HK$862,800	1 Research Assistant Professor (24 man-months/ equivalent)	HK$862,800 (MPF included)
School Development Officers I (Co-coordinator — curriculum)	Assist the Project Directors to administer the operation of the project, oversees and plans teachers' professional development and the implementation of the project, providing all the necessary support to the partner schools in the collaborative teaching resources development processes.	HK$50,475 x 24 months = HK$1,211,400 plus MPF: HK$24,000 = HK$1,235,400	1 SDOs I (24 man-months/ equivalent)	HK$ 1,235,400 (MPF included)
2 Research assistants	Assist the SDOs to provide regular support to 30 schools, help in liaison and preparation work for school supports, taking minutes at project schools, and help in organizing students field works	HK$16,000 x 24 months x 2 = HK$768,000 Plus MPF: HK$768,000 x 1.05 = HK$806,400	2 RA (48 man-months/ equivalent)	HK$ 806,400 (5% MPF included)
Clerical assistant	Assist all administrative and clerical work of the project	$9 815 x 24 months = HK$235,560	1 CA (24 man-months/ equivalent)	HK$247,338 (5% MPF included)

Rank	Description	Staff cost per month	Establishment (Total man-months)	Amount
		Plus MPF: HK$235,560 x 1.05 = HK$247,338.		
Advisor of Remote sensing, Curriculum Development and Technical Manager	Provide professional advices and quality control on the developed products. Conduct seminar, deliver talks for professional development of teachers.	$500 per hour	50 hrs for two years	HK$ 25,000
Student helper	Help in student field trips, and student project competition award ceremony.	$50 per hour	1,000 hours for two years x 20 helpers	HK$50,000
			Subtotal (staff cost)	**HK$4,161,638**

B. Operation expenses

Items	Particulars	Cost
Handheld GPS Devices	GPS Device for capturing sample position in ground truth, $6,000 per set, HK$6,000 x 10	HK$ 60 000
Software development Platform (2 sets)	Two sets of development platform for the tailor-made RS&GIS software needed for the two software developers. CUHK will provide one set of the platform and need to purchase another set from the project budget.	HK$ 11 700
ENVISAT Satellite Remote Sensing Image	The images are received by the CUHK Ground Receiving Station and the cost (~ $HK4,000 per scenes, 20 scenes needed per year) is covered by CUHK.	HK$0
Computer Workstation	Computer workstation for software development, RS and GIS data analysis etc. (8 sets)	HK$0
Other Satellite Remote Sensing Image	Other image sources such as SPOT, LandSAT, Quickbird required by the project.	HK$ 50,000
Training workshop	Production of Training Materials (e.g. CD-ROM, hardcopy handout etc.)	HK$ 10,000
Day-to-day expenses	General expenses include: stationery, transportation, reference books, printings, advertisement, postages, etc.	HK$24,000

Miscellaneous	Computers ($8,500 x 2 + $6,000), printers, books, space utilization, occupancy cost, furniture, financial & accounting services, library service lecture theatre, general utilities and security services supported by the university etc.	HK$100,000
Student project competition	Postage, publication, prize, posters, etc	HK$60,000
Video shooting and editing		HK$ 80,000
Contingency	3% of the total cost excluding staff cost	HK$11,962
	Sub-total (operation cost):	**HK$407,662**
	Grand Total:	**HK$4,569,300**

Annex

Annex 1	How RS&GIS technology helps in different stages of independent enquiry learning projects
Annex 2	Examples of Functions to be developed in the User Friendly Satellite Image Analysis / GIS Software
Annex 3	Examples of RS&GIS related enquiry questions in NSS Geography curriculum
Annex 4	Examples of RS&GIS related enquiry questions in NSS Liberal Studies curriculum
Annex 5	Training plan for the teachers and students from participating schools
Annex 6	Reference

Annex 1 :

How RS&GIS technology helps in different stages of independent enquiry learning projects:

Stage of investigation processes	**Example of learning processes that can be supported by RS&GIS**
Stage 1.	
Identify the issue	GIS Data exploration o Allows searching of the given set of RS&GIS data by any searching parameters (e.g. Where were the major floods in Hong Kong in 80s, 90s, and 2000s?). o Allows students asking questions and identifying issues from the searching results of RS&GIS? (e.g. why the major floods concentrated in Yuen Long in 90s?)
b. Consider the scope of enquiry	RS Data exploration Provide both regular satellite images for continuous environmental monitoring and occasional satellite image in response to emergency event (e.g. flooding, hill fire, earthquake) o Historic satellite images up 80s' provide a good reference for the students to identify the changes in environments.
Stage 2	
Collection of background information	GIS & RS Data Collection o Satellite Remote Sensing images provide a huge, update data resources associating with the studies of the identified issues (e.g. land cover / land use, elevation, vegetation coverage, surface temperature, aerosol, water bodies etc.). o GIS data provides accuracy topographic and demographic information (e.g. contour, building, census information, land use plan etc.) o Students can make use of GPS (Global Positioning System) to collect field data. o Field collected data can be imported into a GIS for the analysis with other relevant information.
Organization of data / other kinds of information	GIS & RS Data Management o Integrates heterogeneous geospatial data (base map, land use, census, satellite images, GPS data etc.) can be integrated for further investigation by registering or transforming them to a common spatial position and projection.
Stage 3	
Analysis of data / information	GIS & RS Data analysis o Provide tools for attribute classification (e.g. classify the original satellite images into habitat classes like shrub, grassland, stream/river, forest, bare land etc.) o Provide tools for analysis of the changes of attribute through time. o Provide tools for descriptions of the properties of spatial patterns (density, dispersion, centroids, regions, outliers). o Provide tools to perform pattern analysis (differentiating random pattern from systematic pattern, regularity or clustering) o Provide tools for overlaying and examining the relationship among geo-spatial data sets.

Evaluation of different points of view	*a. Examine possible outcomes*	• Creation of the "to-be" scenarios o Creation of spatial data showing plans for a more desirable environment from the student's points of view.
	b. Evaluate each possible outcomes	• Visualization o Provide tools for high cartographic quality production for the "to-be" scenarios. o Provide three-dimensional animation showing the impacts of the "to-be" scenarios.
	c. Make judgments / decisions about viable outcomes	• Impact assessment o Make judgments / decisions about the most preferable "to-be" scenarios with the produced cartographic products / visualization. o Bring together the original RS&GIS data, analysis results, and the cartographic products to support the judgments / decisions. o Assess the impacts to the current environment imposed by the judgments / decisions
	d. Make plan to revisit the judgments / decision	

Annex 2

Examples of Functions to be developed in the User Friendly Satellite Image Analysis / GIS Software

New Function	Features
Support for Satellite Image Data Formats	NASA maintains wealth sources of Satellite Images and the software shall support NASA's file format, HDF[1].
Map Registration	Map registration functions using control points or well-defined features in the images (i.e. map-to-map registration) shall be provided.
Overlay of processed images	Function shall be provided for overlaying of both raw data image as well as the processes images from the analysis.
Satellite Image Classification	Functions and procedure shall be developed to conduct supervised classification: classify raw satellite images into student's defined classes.
Pixel-based Search Functions	Functions shall be developed for searching the all pixels within a given regions (sum up the numbers of pixel for various habitats within the entire image or a given region).
GPS Data Import	Function shall be developed for importing field-collected data using GPS[2].
GIS Data Import	The software shall provide function to import GIS Data (in common data format) and overlay GIS Data with satellite images.
Simple GIS Data Query	The software shall provide tools to execute simple spatial query to GIS Data.
Simple Mapping	Functions shall be developed for adding legend, map title, gridlines and other information.
Export to other GIS File Format	Functions and procedures shall be developed to export the processed images as well as the underlying co-ordination system to common GIS file format.
Support for Traditional and Simplified Chinese	The software shall support the users interface in Traditional Chinese, Simplified Chinese and English.

[1] HDF - Hierarchical Data Format
[2] GPS – Global Positioning System

Annex 3

Examples of RS&GIS related enquiry questions in NSS Geography curriculum

NSS-Geo Curriculum	Remote Sensing Learning Activities	Discussion topics
Opportunities and risk – is it rational to live in hazard-prone area.	Activities: Study the satellite images taken before and after the tsunami in Indonesia and Thailand, 2004 and, with the image measurement tools to evaluate the direct damages of the hazards.	Discuss effective of satellite technology as well as other monitoring, predicting, warning technologies can reduce the impact of natural hazards.
	Study the satellite images taken before and after the "512 Earthquake in Sichuan" and identify the direct damages of the hazards.	Identification the major hydrological infrastructure in Sichuan and discuss if it is rational to build the facilities in the earthquake-prone region.
Managing river and Costal Environments: A continuing challenge	Study the flooding and drought events in Poyang Lake and Dongting Lake by extracting and measuring the water bodies using time series satellite images.	Through satellite images and image analysis results, together with other information from newspaper and Internet, evaluate the causes and consequences of the events.
Changing Industrial Location – How and why does it change over space and time?	Using satellite images and image analysis tool to create a land cover map of Pearl River Delta in 80s', 90s' and 2000s'.	Identify the change of location of manufacturing industry from Hong Kong to Pearl River Delta (PRD).
Building a Sustainable City – Are environmental conservation and urban development mutually exclusive	Create a simple land cover map of Hong Kong using satellite image of 80s', 90s' and 2000s' and evaluate the urban growth and urbanization of Hong Kong though time.	Evaluate the urban problems associating with urban growth of Hong Kong. (The changes of PRD is more obvious)
Combating Famine – is technology a panacea for food storage.	Thought the satellite images of a rainforest over time, describe the farming activities in Guangdong in 70s, and 90s.	Discuss the factors determining the farming characteristics of Guangdong
Disappearing Green Canopy – who should pay for the massive deforestation in rainforest region?	Through the satellite images of a rainforest over time (1980s' to 2000s'), calculate the NDVI and evaluate the destruction rate of forest.	Combining the image analysis results and other information, discuss the causes of deforestation in that rainforest.
Global Warming – is it fact or fiction?	Compare the time series satellite images of major glaciers and measures the area of glaciers melt in the last decades.	Can the melting of glaciers be an indicator of global warming?
Weather and Climate	Compare the images and identify the seasonal trend of distribution of aerosol. Compare the seasonal trend with the monthly visibility data published by the Hong Kong observatory.	Discuss the seasonal variation of aerosol in South China.
Transport Development, Planning and Management	From the satellite images of PRD, identify and major cities and overlay the images with the current and future transportation infrastructures in the region.	Comments if the existing (and future) transportation infrastructures facilitate Hong Kong being a transport and logistics hub in the region.
Regional Study of Zhujiang (Pearl River) Delta	With satellite images of PRD, using image analysis tool to classify the land cover type agriculture, forest, river, urban etc.	Discuss the urbanization process in PRD.

Annex 4

Examples of RS&GIS related enquiry questions in NSS Liberal Studies curriculum

Module	Theme	Examples of questions for enquiry	Examples of questions that involve spatial or RS&GIS data
1	Personal Development and Interpersonal Relationships—**Interpersonal relationships**	What motivates Hong Kong adolescents to participate in community affairs? (CDC, 2007, P.21)	➢ Locate the major adolescents participated community affairs in Hong Kong in the last 10 years. ➢ Do the patterns of participation vary across the different districts in Hong Kong?
2	Hong Kong Today—Quality of life	What are the different opinions of Hong Kong residents on the priorities which constitute of life? (CDC, 2007,P.27)	➢ Do the opinions vary across the different districts in Hong Kong? ➢ If so, do the variation matches with spatial patterns of some factors such as unemployment rate, income, average age, etc.
2	Hong Kong Today—Rule of law and socio-political participation	What factors determine the level and form of socio-political participation by Hong Kong residents? (CDC, 2007,P.29)	➢ Do the forms of socio-political participation vary across the different districts in Hong Kong? ➢ If so, do the variety matches patterns of some factors such as ethnicity, gender, social status, education level, age, etc.
3	Modern China—China's reform and opening-up	How have the changes in living standard and the way of life been viewed across the whole country? (CDC, 2007,p. 35)	➢ Identify the changes (and the spatial pattern of changes) for the GDP, economic growth, educational and health indicators across the various provinces in the whole country from 1980s-2000s. ➢ Identify urbanization of major China cities using satellite images acquired from 1980s 0 2000s.

Module	Theme	Examples of questions for enquiry	Examples of questions that involve spatial or RS&GIS data
4	Globalization	Is globalization a blessing or a curse to human beings? (CDC, 2007,P.40)	➢ Find out the changing pattern of some elements related to globalization, (e.g. economic growth, rate and pattern of information/culture / disease spread) and relate this to some factors affect quality of life. ➢ Identify the growth of major cities from satellite images.
5	Public Health	In what ways is people's understanding of public health affected by health information, social expectations, personal values and beliefs in different cultures? (P.44)	➢ Find out the pattern of disease flow and the relations to some other factors (e.g. international travels and communications, GDP, living environment, patterns of trade, etc.)
6	Energy Technology and the Environment	To what extent does the development of energy technology create or solve environmental problems? (CDC, 2007,P.48)	➢ Using Satellite Images and GIS data to study the issues of depletion of ozone layer, global warming and acid rain. ➢ Study the changing patterns of environmental quality and compare with the patterns of e.g. utilization of energy technology, GPD, major industrial types,
		How do science and technology match with sustainable development? (CDC, 2007,P.50)	➢ Study the spatial patterns and relationships among the quality of living environment, demand of energy, industrial types, use of natural resources as well as resource allocation in a western country and a developing country.

Annex 5

Training plan for the teachers and students from participating schools

1. Training course to be organized for the seed schools

Topics related to student projects	**Details**
Introduction on Satellite Images and GIS	An introduction on the basic concept and education related functionalities of satellite images and GIS.
Suggestions on student project using Satellite Images and GIS	An introduction on satellite images and GIS and how the image could be used in student project. The steps of starting a project will be explained.
An Introduction on the satellite images resources	Satellite images from the satellite receiving station of CUHK (ENVISAT ASAR, ASTER, CIR Photos etc.), NASA, USGS, Free SPOT-4 / SPOT-5 vegetation products, Google Earth etc.
Common images analysis skills useful to IES Project	Simple image analysis skill such as image classification, image enhancements, rectifications, image registration etc.
Ground Truth and GPS Data Collection	The results of image analysis shall be evaluated with field data (i.e. Ground truth). Techniques for the selection of location, types of ground sample points, GPS data collections will be covered.
Combining Remote Sensing Data with other data sources	Exporting analyzed satellite image to GIS software as well as importing GIS data to satellite image processing software. Conduct co-ordinate transformation such that all data align with common co-ordinate system.
Study cases	Two study cases will be developed to practice the techniques included in the packages, examples of the study cases include: i. Produce the Land Cover Map for the CUHK Campus. Techniques include images enhancement, images classification, collect GPS and ground truth, integrate analyzed images with other GIS data and map production. ii. Study the usage of abandoned farmland in Yuen Long: Techniques include classification of farmland in Yuan Long in 80s' and 2000s', discover changes of usage on the farmland, and to comment if the changes impose environment impacts to Yuen Long district.

2. Training course to be organized for the participating schools

Topics related to student project	**Details**
Introduction on Satellite Images and GIS	An introduction on the basic concept and education related functionalities of satellite images and GIS.
Suggestions on using Satellite Images and GIS in student project	An introduction on satellite images and GIS and how the image could be used in IES. The steps of starting an IES will be explained.
Useful RS&GIS skills used in the showcases developed by the seed schools	**Data Collection** An introduction of satellite images used in the showcases developed by the seed schools including satellite receiving station of CUHK (ENVISAT ASAR, ASTER, CIR Photos etc.), NASA, USGS, Free

Topics related to student project	Details
	SPOT-4 / SPOT-5 vegetation products, Google Earth etc. **Simple Image Analysis** An introduction of simple, practical image analysis skills employed in the showcase projects. **Field Survey Using GPS** The results of image analysis shall be evaluated with field data (i.e. Ground truth). Techniques for the selection of location, types of ground sample points, GPS data collections will be covered. **Create Project Specific Data in GIS** Skills of collecting project specific data and integrate the data into GIS. **Integration with GIS Data** Skills required to export / import satellite images & GIS data and co-registration of the various sources of data. **Map production** Skills required to produce high quality maps for report purposes.
Study cases	Details walkthrough of two study cases developed by the seed schools to practice the essential techniques.

3. Training course to be organized for the students

For the students and teachers from 30 schools to join the student project competition

Topics related to student project	Details
Introduction on Satellite Images and GIS	An introduction on the basic concept and education related functionalities of satellite images and GIS.
Suggestions on IES using Satellite Images and GIS	An introduction on satellite images and GIS and how the image could be used in IES. The steps of starting an IES will be explained.
Case Study	Details walkthroughs of the study cases developed by the seed schools / participating schools to practice the essential techniques: 1. Data Collection 2. Simple Image Analysis 3. Field Survey Using GPS 4. Create Project Specific Data in GIS 5. Integration with GIS Data 6. Map Production
Student Projects Plan	Prepare for the student project proposal: 1. Group discussions on project topic. 2. Essential contents in the student project proposal. 3. Develop a draft project proposal. 4. Proposal presentation.

Annex 6

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