SCHOOL-BASED CURRICULUM INNOVATION (SCI) PAPER

School:	Henry Park Primary School
Title of SCI:	Phyzwurx Experiential Learning
Network / Curriculum Focus:	Unleashing Potential
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Abstract of SCI

This paper describes the journey of innovation in Henry Park Primary School. The school has embarked on several innovation projects (initiated by teachers), the latest of which is called 'Phyzwurx', which stands for Physics at Work Everywhere. This innovative project focuses on the teaching and learning of Physical Sciences in the school.

The school Research Activist has gathered evidence to show that the Phyzwurx experiential learning enhances the cognitive domain, attitudes and level of engagement in science among Primary Three high-ability pupils in Henry Park Primary School.

The 5E Instructional Model and Kolb's Theory of experiential learning are used in the design of teaching packages. The Ministry of Education (Singapore) Science Curriculum Framework is also highlighted, as central to the curriculum framework is the planned inculcation of the spirit of scientific enquiry.

To debunk the idea that many students find the learning of Physics as abstract and dry, Phyzwurx was conceptualized to teach Physics in a fun and interactive way. The Paper also describes the Phyzwurx Approach and the implementation plan within the school.

Introduction:

Thinking Schools, Learning Nation (TSLN) was adopted as the vision statement for MOE in 1997. It continues to be the over-arching descriptor of the transformation in the education system, comprising changes in all aspects of education. These changes articulate how MOE would strive towards the Desired Outcomes of Education (DOE).

Since 2003, we have focused more on one aspect of our DOEs, i.e. nurturing a spirit of Innovation and Enterprise (I&E). This will build up a core set of life skills and attitudes that we hope to see in our students. It promotes the mindsets that we desire to see in our students, teachers, school leaders and beyond.

Henry Park Primary School embarked on several innovation projects in support of TSLN and I&E. The recent innovation project 'Phyzwurx' is one of our Teach-Less-Learn-More (TLLM) initiatives that is school-based.

Literature Review

The 5 E's is an instructional model based on the constructivist approach to learning, which says that learners build or construct new ideas on top of their old ideas. The 5 E's can be used with students of all ages, including adults. Constructivism is a learning strategy that draws on students' existing knowledge, beliefs, and skills. With a constructivist approach, students synthesize new understanding from prior learning and new information.

The constructivist teacher sets up problems and monitors student exploration, guides student inquiry, and promotes new patterns of thinking. Working mostly with raw data, primary sources, and interactive material, constructivist teaching asks students to work with their own data and learn to direct their own explorations. Ultimately, students begin to think of learning as accumulated, evolving knowledge. Constructivist approaches work well with learners of all ages, including adults.

Recently, two more E's have been added to the model. 'Elicit' was added to the 'Engage' part, which adds the important step of accessing students' prior knowledge. This is an important part of getting kids ready to learn. And 'Extend' was added to the 'Elaborate' component as a way to get kids to transfer some of their knowledge into other learning opportunities. This is important for students to ultimately connect their learning in science to the world, starting with other school subjects, and beyond that to the working world. We need to show our students how the concept or skill is practical or useful in real life. That's why the 'Extend' was added.

David Kolb (1984) defines learning as "the process whereby knowledge is created through the transformation of experience". He says that experiential learning has six characteristics:

- It emphasizes how learning takes place, instead of what is to be learned.
- Learners continuously gain and test knowledge through, and in terms of, their experiences.
- Learners need abilities that are opposites. Choices are made among opposites – concrete experience or conceptualizing abstractly; actively experimenting or reflectively observing.
- Learners are asked to adapt in a holistic way, to their social and physical environment.
- It is an active, self-directed process involving transactions between the learner and the "real-world" environment.
- Knowledge is created within learners.

The Research Questions are:

- Do Phyzwurx students score higher in science achievement test than non-Phyzwurx pupils?
- Do Phyzwurx students display more positive attitudes towards science than non-Phyzwurx pupils?
- Do Phyzwurx students demonstrate a higher level of engagement in the learning of science than non-Phyzwurx pupils?

Methods:

Quasi-experiment design was used in the research.

Participants: Primary Three High-Ability Pupils. Both groups were found to be statistically equal before intervention.

Pre and Post tests and surveys were administered to both groups using:
(1) Science Achievement Test
(2) Science Attitude Survey (adapted from TOSRA)
(3) PETALS Engagement Indicator

Findings / Conclusion :

Phyzwurx experiential learning enhances the cognitive domain, attitudes and level of engagement in science among Primary Three high-ability pupils in Henry Park Primary School.

References:

- Consuegra, Gerard F. The 5 E Instruction Model. Available at http://umassk12.net/earth/presentations/5ENASA.ppt, 9 September 2008.
- Lang, Hellmut R., & Evans, David N. (2006). *Models, Strategies, and Methods for Effective Teaching* (pp. 368 – 393). Boston: Allyn and Bacon.
- *Syllabus Science Primary Standard/Foundation (2008).* Curriculum Planning & Development Division. Ministry of Education, Singapore.
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(Implementation details)

With the Phyzwurx concept in mind, a room was refurbished and equipped with facilities that enable students to learn Physics through toys and 'everyday things' around them. In 2005, Phyzwurx was launched in Henry Park Primary School and was hence used extensively in the school when teaching topics in Physics in the Primary Science Syllabus. With the same concept in mind, we extended Phyzwurx beyond the room to the whole Henry Park Campus to create an authentic setting outside classrooms.

The concept of Phyzwurx is anchored on meaningful play and first-hand experience. Through first-hand experience and learning in a fun manner, students can draw better linkages to key concepts, gain enduring understanding and have greater appreciation of the world of science.

The target group for Phyzwurx will be the high-ability students from the mainstream in the cluster schools. While the top 1% of students in the primary section are identified and channelled to the Gifted Education Programme, we are aware of the remaining 2 to 9% of bright students that could benefit from a more challenging programme. By increasing the depth and breadth of the Primary Science syllabus, we hope to provide these students with opportunities to achieve peaks of excellence.

The campus will be divided into four main zones, each carrying a theme. The themes will be chosen in a manner such as to capitalize on students' interests, aligned with Phyzwurx's concept of play and everyday experiences.

The design and construction of Phyzwurx will be implemented in 2 phases:

A group of teacher advocates will be involved in the design of the zones and the creation of lesson packages in each zone. They will be representatives from cluster schools. While the teacher advocates are armed with the necessary pedagogical knowledge, they may not have the advance content knowledge required to ensure accuracy in the content and structural designs.

As such, we propose to harness professional support from A*STAR and the Science Centre Singapore in the design and creation of both the physical facilities and the lesson packages that complement them. One possibility that we are exploring is to attach teachers to identified personnel in these organisations who are their consultants in the project. The attachment will enable them to gain greater insights into specific physics topics.

Phase One	**Phase Two**
Playground Science • Design and construction • Creation of lesson packages	Sports Science • Design and construction • Creation of lesson packages
Material Exploration I • Design and construction • Creation of lesson packages	Material Exploration II • Design and construction • Creation of lesson packages
Everyday Science I	Everyday Science II
Demonstration arena	

Curriculum Package:

- A curriculum package consists of four lessons on Material Exploration was designed and developed by a group of teachers from the school.

- Pupils were introduced to the concept of polymer and examined different types of plastics. In addition, they learned that the properties and appearance of a polymer can be changed by mixing different polymers. They also examined the effects of the resulting polymer by changing one of the variables.

Physical Facilities:

1. Playground Science – Explore the principles and concepts behind the different items commonly found in playground.
2. Sports Science – Explore how principles in physics apply in sports and games and how physics is related to life sciences (e.g. the structure of the human body) and concepts behind the different items found.
3. Material Exploration – Explore modern day materials e.g. polymers, composites, etc.
4. Everyday Science – Further raise awareness the prevalence of principles in physics in common facilities like ramps, elevators.

Teaching Strategies:

1. The 5E Inquiry-based approach
2. Kolb's experiential learning theory

Partnerships:

The school works in collaboration with external organizations. Expertise/Consultancy and financial support will be provided through our partners in Science Centre Singapore and A*STAR respectively.