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In Search of Innovative ICT in Education Practices

Student Peer Teaching Strategy, Malaysia

Case Studies from the Asia-Pacific Region

Student Peer Teaching Strategy, Malaysia

Tan Tee Hwa

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Preface

A wise person once said, "*If students do not learn the way we teach, then let us teach the way they learn*."

That is what educators have been trying to do through the use of information and communication technologies (ICT).

UNESCO believes that integrating ICT into education can help to bring quality education to everyone, everywhere – a key goal of the Education for All initiative. The citizens of the future must be equipped with sufficient knowledge to keep up with technological advances and demands of the 21st Century.

UNESCO also believes that recognizing innovative ICT in education practices can encourage and enhance even more educational innovations. With the support of the Japanese Funds-in-Trust, the Asia-Pacific Programme of Educational Innovation for Development (APEID) of UNESCO Bangkok implemented a project on Innovative Practices in ICT in Education to identify, document, share and multiply ICT in education innovations.

As part of the project, the UNESCO ICT in Education Innovation Awards was launched in 2007 to recognize outstanding work by (i) teacher and teacher educators, (ii) educational planners and administrators, and (iii) non-formal educators. Another component of the project was the documentation of innovative practices to increase the awareness and knowledge of teachers, educators, principals, administrators and policy makers to the potential of ICT in helping them achieve their educational goals.

Our search for excellence, showcased in this series of case studies, is a testament to the innovative spirit of educators. The case study in this booklet presents the Student Peer Teaching Strategy by Ms. Tan Tee Hwa. Ms. Tan received a Certificate of Commendation in the 2007-2008 UNESCO ICT in Education Innovation Awards for her efforts.

Without doubt, these innovators will be very pleased that their projects are recognized and appreciated. Still, we believe that they will feel more gratified when their efforts are adopted and put to good use by others. That is the ultimate reward they, and UNESCO, seek.

Molly Lee
Coordinator
APEID, UNESCO Bangkok

Acronyms

APEID	Asia-Pacific Programme of Educational Innovation for Development
e-lesson	electronic lesson
ICT	Information and communication technology
KLCC	Kuala Lumpur Convention Centre
SMK	Sekolah Menengah Kebangsaan (National Secondary School)
SPTS	Student Peer Teaching Strategy
UNESCO	United Nations Educational, Scientific and Cultural Organization

Introduction

Sekolah Menengah Kebangsaan (SMK) Padang Tembak, a fully government-aided national secondary school in Kuala Lumpur, is situated in a unique location. It is close to the famous Kuala Lumpur Convention Centre (KLCC) with a good view of the Petronas Twin Towers, and also faces a large squatter settlement for immigrants. Due to the proximity of two government departments – the Ministry of Defence and the Centre for Training Police Officers – the families of many students are affiliated with either the army or the police.

The school has an average annual enrolment of about 1,400 students, most of whom are Malays, with about 5 percent Indians, a few Chinese and other ethnic groups. The majority of the students are from lower income families.[1] The students are conversant in Bahasa Melayu, the national language, but have difficulties speaking and writing in English. The academic performance of the school has been mediocre.

I was a physics/science teacher in SMK Padang Tembak from 1989 to 2005, but had also taught Chemistry when necessary. In February 1997, I was diagnosed with a prolapsed spinal disc that left me physically handicapped and unable to raise my right hand to write on the board or to conduct experiments. My voice which had been loud enough for classroom teaching could only be heard by the students in the first row in class.

Being responsible for four O-level examination classes at that time, I knew it would be very difficult for the school to find a replacement to take over my classes if I were to resign. I also recognized that my students could not afford private tutors if they needed extra coaching. There was no other choice but to find a solution to prepare the students for their examinations despite my handicaps. They could both be easily replaced by those of someone else.

Consequently, I enlisted two of my brightest students to assist me. They remained after school for me to teach them the concepts, train them to handle the equipment in the laboratory and guide them in preparing the transparencies for the lessons. Thus began the Student Peer Teaching Strategy (SPTS).

During classes, the two student teachers became my voice and my hands. I was there to maintain discipline and to correct my two conscripts when necessary. Colleagues and friends who could use the computer helped me to prepare the transparencies of the notes for the lessons. I felt guilty about burdening the two students this way, but we continued in this fashion for six months until I recovered from my medical condition, upon which I immediately reverted to the traditional mode of teaching.

When the O-level examination results were released in April 1998, my two student teachers broke the school's 20-year old record for academic excellence. Both scored a string of distinctions. The school also saw a huge improvement in academic excellence. I could only

1 In 2004, the monthly income of 64 percent of the families was about MYR 1,500 (MYR 1 = US$ 0.27, April 2009 rate).

conclude that SPTS had a profound impact on the student teachers and student learners from these unexpected achievements.

In spite the positive outcome, I tried to stop using the student teachers for several reasons. I had regained the use of my hand, so there was no justification for asking others to do my work. I was particularly reluctant to burden my students with my teaching duties. However, more compelling were my lack of skills in using the computer to prepare the transparencies and my preference for the more familiar and comfortable traditional teacher-centred style of teaching. Nonetheless, when I had to be away from my classes to attend other official duties, I fell back on SPTS to ensure that my students were able to continue their lessons. In 2001, one student in particular forced me to reconsider my decision.

This student skipped my classes for two months. When I finally confronted him, he complained that he found it difficult to comprehend abstract physics concepts and that my teaching style was boring. More conversations with him and other students led me to realize that they all shared the same frustrations. He and his peers had access to a broad range of interesting and rich media outside the classroom, but the school still subjected them to the traditional way of passive and rote learning. This was the turning point in my resolve to be more student-centred and use SPTS, this time with a difference by incorporating information and communication technology (ICT).

The Next Steps

ICT was gradually integrated into the classrooms by the end of 2000. Students enjoyed the lively animations as well as interactions through the computer and internet. SMK Padang Tembak established a computer lab in early 2001. As a result of this development, my school principal enrolled me in the Intel Teach to the Future programme in May 2001. While the Intel Teach programme equipped me with skills to incorporate ICT into lessons, it also required me to teach these skills to other teachers and students in my school.

The students had to prepare and submit electronic lessons (e-lessons) as proof of their acquired skills. Since most of them had no access to computers at home, the school permitted the students to use the computer lab under the supervision of their teachers. The response and enthusiasm were beyond my expectations. Every day for four weeks, the students stayed back after school to use the computer and internet to search for songs, pictures, animations and movies to illustrate their lessons. They also looked for practical activities to help them understand the concepts being taught in class. For example, they decided to build water rockets to demonstrate Newton's Laws of Motion, and a competition was launched to test their creations. The most rewarding moment was when the student who skipped my physics class for two months won the rocket contest!

With increasing proficiency and confidence in using ICT, I organized students into groups and assigned topics for them to conduct research, prepare lessons and materials to teach their classmates. For example, one group was assigned to teach Newton's laws of motion

using the water rockets. A second group taught Pascal's law on pressure with the help of a bicycle. Another group worked on water waves. The outstanding physics test results reaffirmed the impact of active learning and peer teaching. In fact, one student teacher increased from his average score from 48-52 percent to 76 percent.

These early successes helped to establish the three key components of SPTS:

- Preparation of e-lessons using ICT
- Organization of hands-on activities and/or creation of some output
- Peer teaching using the e-lessons

The Student Peer Teaching Strategy

The Student Peer Teaching Strategy is first and foremost student-centred and emphasizes active teaching and learning approaches. Teachers and students both play active roles to induce *hands-on, heads-on and hearts-on* learning in the students. The students work in teams to prepare e-lessons instructional materials under the mentorship of their subject teachers using ICT resources such as CD-ROMs, internet, digital cameras, video cameras and PC microscopes. They practise and perfect their hands-on activities, capturing their demonstration on slides. These visual versions of the actual experiments, activities and projects are a critical part of the e-lessons to help the learners observe experiments clearly. Activity worksheets are also prepared by the teams to complement and consolidate the lessons.

The student teams then teach their personalized e-lessons to their peers in the same grade and students in junior classes, and sometimes in demonstration classes to interested teachers and educators. They divide the various tasks – introducing the lesson, explaining and demonstrating the hands-on activities, supervising and assisting the student learners in the laboratory – among themselves, trying to match the task to the talent and personality of each team member.

SPTS emphasizes the processes as much as the products. While it is important that students develop and deliver some concrete outputs, the processes involved in getting the end results promote critical thinking and social skills among the student teams and highlight their differing, but equally valuable, styles and abilities.

Implementation of the SPTS

One innovative way to implement SPTS is through a competition since it creates a lot of interest and enthusiasm among the students, and provides many opportunities for hands-on learning experiences. At the same time, mentor teachers need to supervise and guide the student teams as they research, prepare the teaching materials and practice the delivery of their lessons throughout the year. The following steps have proven useful for organizing such a competition and for helping the teachers to be effective mentors.

a. The competition

1. Set a date for e-lessons to be submitted for judging.
2. Announce the prizes and set the guidelines.
3. Heads of departments identify the topics for the lessons based on what is needed to enrich student learning for the year.
4. Class teachers divide the classes into groups.
5. Each group selects one topic to prepare an e-lesson accompanied by an activity sheet.
6. The mentor (subject) teacher works with the group.
7. The lesson must have ICT inputs – texts, pictures, applets, audio, video, etc.
8. 50 percent of the marks are given for the e-lesson and activity sheet and how they enhance the lesson.
9. Set the dates for the groups to teach a class before a panel of judges.
10. Mentor teachers work with the groups to ensure that some basic skills are learnt:
    - Question and answers techniques
    - Communication and articulation skills
    - Working as a group
    - Hands-on skills
    - Filling the activity sheet
11. Mentor teachers arrange for student groups to practice their teaching in class.
12. Prepare comment sheets to allow the students to give constructive criticism to groups and help them improve before they face the judges.
13. 50 percent of the marks are awarded for teaching a new class before the panel of judges.
14. Enhance and improve the e-lessons for use in other classes after the competition.

b. Regular activities throughout the year by one teacher or one department

1. The teacher/department provides the topics and dates for the student groups to teach the lessons in class.
2. Each class is divided into groups of four.
3. Each group selects a topic.
4. The teacher mentors the groups for about two months before the topic is taught.
5. The mentoring process involves giving reading assignments, evaluating students'

understanding, pre-teaching the concepts, designing the storyboard with the teams, delegating responsibility for the slides and ensuring the e-lessons and activity sheets are completed on time.

6. The e-lessons and activity sheets are collected one month before the lessons and 50 percent of the marks are awarded based on the submissions.
7. The teacher mentors the groups again by training them and improving their communication skills to teach the lessons in class as well as to handle the hands-on activity, laboratory apparatus and other skills.
8. The groups improve their lessons and the students are judged during the actual lessons.
9. Prizes are awarded at the end of each term for best group.

c. Designing the storyboard

- Name of students and teacher involved (Slide 1)
- Introduction of topic/menu (Slide 2)
- Experiment/projects/competitions/activity related to topic (*Hands-on*)
- Define concept (*Heads-on*)
- Brief history (*Heads-on*)
- Applications in everyday life (*Heads-on*)
- Examples of questions and answers – interactive style (*Heads-on*)
- Examples of past years' questions and answers (*Heads-on*)
- Give credit for material, software, pictures, music (*Hearts-on*)
- Activity sheet (*Heads-on*)

d. Role of mentor teachers

Assignments	Month
Introduce juniors/novices to SPTS by having seniors teach juniors	Jan-Feb
Prepare list of topics needed – include difficult topics as well as topics for lesson banks	Jan-Feb
Schedule dates for students to teach these topics	Jan-Feb
Divide class into groups – one smart student, two average students and a weaker student	Jan-Feb
List the resources – pages in textbooks, CD, internet website	Jan-Feb
Student groups to copy templates and preview old lessons	Jan-Feb
Student groups begin reading assignments and research	March
Evaluate students' understanding and correct all misconceptions	March
Design storyboard and assign slides and work to groups	March
Groups prepare new slides and complete the lesson plans, materials and activity sheets (the holiday period in March is a good time for the groups to prepare slides)	March

Assignments	Month
Evaluate 1st draft of the PowerPoint presentations and activity sheets, and troubleshoot and help students to improve their work	April
Duplicate activity sheets and comment sheets	April
Order apparatus and materials needed for hands-on activities	April
Term examinations – all work put on hold	May
Long term break – a good opportunity for students to practice their presentations	May-June
Conduct peer teaching evaluation	June-Sept

Outcomes of SPTS

The school and teachers won several awards and prizes for the quality of the e-lessons. This in turn led to increasing interest from the press, private sector, universities and the Education Department, enabling the student teachers to demonstrate their skills adeptly in front of a broad range of observers.

One noticeable change was the increasing use of the computers by both teachers and students in the school. Another unexpected outcome was the positive attitude among the students in learning English when they realized that most information available through the internet is in English and not in Bahasa Melayu, the national language.

At the end of 2002, ten groups of student teachers who had completed the year-end examinations were co-opted to translate their PowerPoint lessons from Bahasa Melayu to English so that they could be uploaded and shared through the internet. These were later included in a website maintained by the University of Colima in Mexico (http://ceupromed.ucol.mx/sptss) in 2004.

This project motivated the students to stay in school during the last two weeks of the term, rather than play truant or work part-time to supplement their families' income, a common practice among the students. Through the short time spent on the project, the students' English language skills developed in tandem with their self-esteem and confidence because they realised that their work was good enough to be shared with students in other countries.

Improvement in the examination results has also been significant with the use of SPTS. In 1997, when SPTS was first implemented, the O-level examination pass rate rose sharply from 63.68 percent in 1996 to 84.65 percent in 1997 (Figure 1). At the same time, the number of Grade One students jumped from 17 to 76 students (Figure 2). Subsequently, the pass rates since 2001, when SPTS was reinstated in the school, were above 90 percent except for 2002. That year saw some teething problems because we relied too much on ICT and not enough

on the basics of understanding examination questions. Since then we have remedied the problem by placing a stronger emphasis on documenting learning through the activity sheets (see Annex 1 for an example of an activity sheet).

At the end 2005, I was promoted and transferred to another school, SMK Seksyen 5 Wangsa Maju, to be the Deputy Principal. This is a government national secondary school in suburban Kuala Lumpur with 122 teachers and 11 non-academic support staff. The students are from average to high-income families. This school should comfortably house only 900 students, but currently there are 1,850 students, including 89 with learning difficulties admitted under the school's integration programme. There are 51 regular classes for the mainstream students and 12 classes for students with learning difficulties. The racial balance of the students is 75 percent Malay, 15 percent Chinese, 10 percent Indians and others.

In 2006, I implemented SPTS in my SPM O-level classes. Despite the overcrowded classrooms and heavy workload, the school's performance in the examinations improved substantially and received accolades from the Ministry of Education and the Kuala Lumpur Education Ministry (Figure 3).

Figure 1: SMK Padang Tembak's O-level Examination Pass Rate, 1990 to 2004

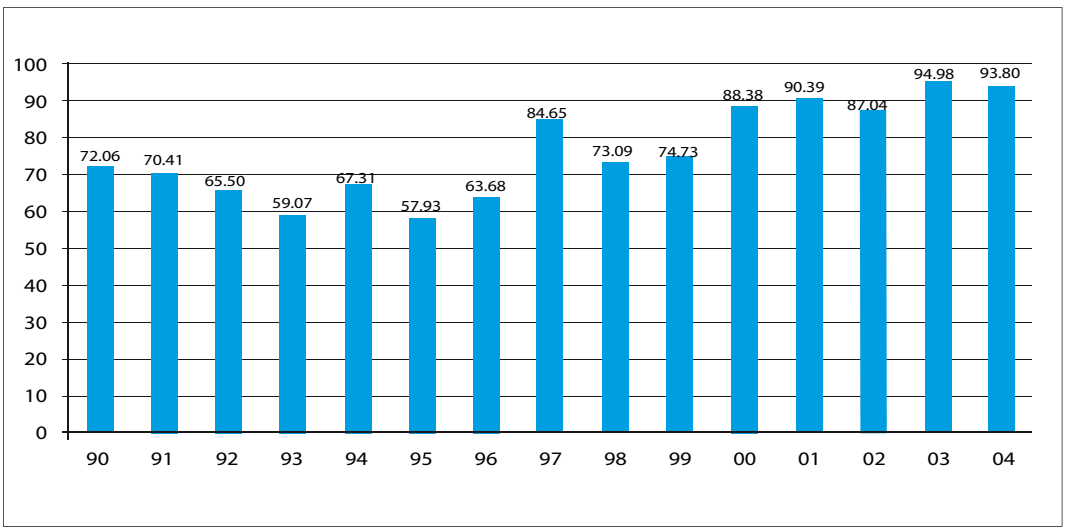


Figure 2: SMK Padang Tembak's O-level Examination Results, 1990-1999

	SMK Padang Tembak, Kuala Lumpur									
	SPM O-Level Examination Results 1990-1999									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Grade 1	18	25	17	23	32	13	17	76	79	77
Grade 2	34	41	35	44	55	34	66	90	74	74
Grade 3	95	72	79	47	53	48	59	38	48	56
No. Passed	147	138	131	114	140	95	142	204	201	207
No. Candidates	204	196	200	193	208	164	223	241	275	277
No. Fail	57	58	69	79	71	69	81	37	74	70
Absent	3	-	2	-	3	2	-	3	3	3
% Passed	72.06	70.41	65.5	59.07	67.31	57.93	63.68	84.65	73.09	74.73

Figure 3: SMK Seksyen 5 Wangsa Maju's O-level Examination Results, 2001-2006

	SMK Seksyen 5 Wangsa Maju, Kuala Lumpur					
	Comparison of SPM O-Level Results 2001-2006					
Year	2001	2002	2003	2004	2005	2006
No of Excellent Students	17	9	27	41	38	58
% of Excellent Students	9.61	4.76	12.8	19.3	14.9	22.7
% Passed	98.3	33.05	98.56	96.23	98.41	98.46
*Average Grade	5.28	5.97	5.37	4.98	4.91	4.81

*Best average grade is 1.00 on a scale of 1 to 9

Taking the opportunity to develop the students' potential and skills as early as possible in the new school, I introduced SPTS to Form 2 classes after their year-end examinations in 2006. With the help of the department heads and form teachers, competitions were organized for all Form 2 classes to prepare e-lessons and peer teach these lessons. Again, the performance of this cohort of student teachers improved significantly when their Form 3 public examination results were announced in 2007 (Figure 4).

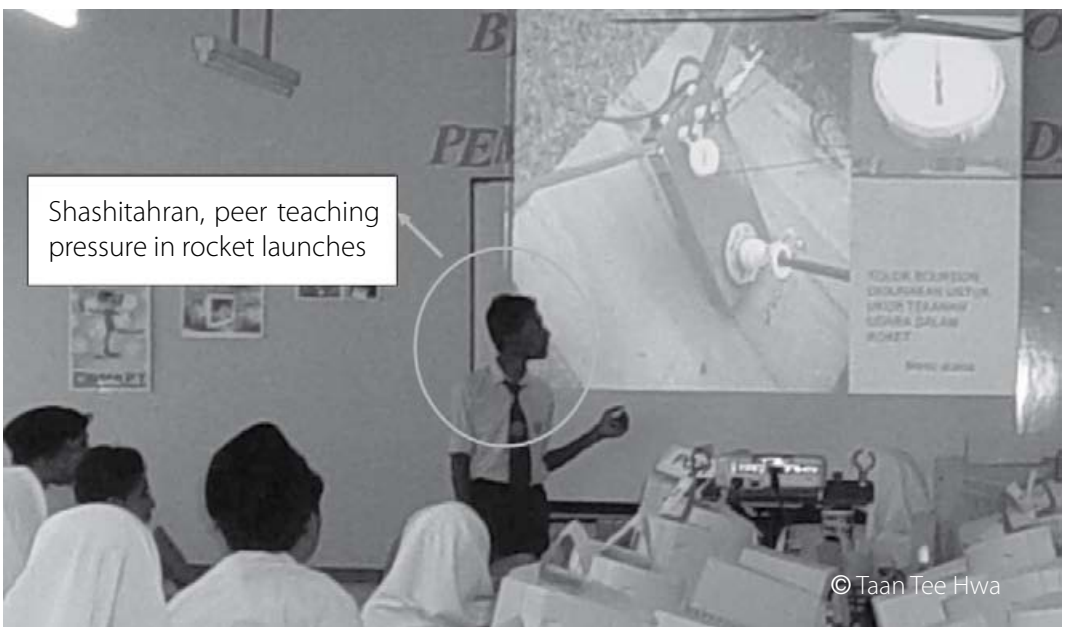
Figure 4: SMK Seksyen 5 Wangsa Maju's Form 3 Examination Results, 2002-2007

	SMK Seksyen 5 Wangsa Maju, Kuala Lumpur					
	PMR Form Three Results 2002-2007					
Year	2002	2003	2004	2005	2006	2007
No of Candidates	270	305	308	299	301	335
% Passed	92.2	92.1	87.7	90.97	87.04	91.6
No of all A Students	41	35	39	41	32	57
% of all A Students	15.2	11.5	12.7	13.7	10.63	17.01
*Average Grade	2.13	2.1	2.2	2.07	2.26	2.12

*Best average grade is 1.00 on a scale of 1 to 5

The impact of SPTS on the performance of the students was reinforced when a review of their results showed that they scored distinctions in subjects that incorporated SPTS, but poorly in subjects that did not. The increase in the students' confidence and self esteem was evident when they presented their lessons competently to their peers, teachers, high-level officials and the public. A less obvious, but equally important, consequence was the development of their 'soft' skills – higher order thinking skills, communication skills, teamwork and other social skills. Finally, the greatest reward to any teacher was to witness the joy of learning on the students' faces as they actively and interactively taught and learnt with their peers.

Figure 5: Student Peer Teaching in Action



Factors for the Success and Constraints of SPTS

The availability of ICT was a main factor that led to the success of SPTS. At SMK Padang Tembak, the establishment of the computer lab was instrumental in providing the students the means to learn how to use computers. Internet access in the lab empowered the students to find rich and relevant information far beyond their textbooks. They were able to search for information from educational CD-ROMs such as the *Encarta Encyclopaedia* and CD-ROMs compiled by universities. The newly installed LCD projector linked to a computer was the key device that enabled the students to use the slides they had prepared. The pioneering SPTS lessons in 1997 relied on hand-written flipchart paper or transparencies as teaching aids. In 2001, SPTS had advanced to more interesting modes of presentation because of the availability of ICT in the school.

The comfortable air conditioned environment in the lab made the students willing to work long hours since it was more conducive to learning than at their homes. Learning together in the computer lab was also more fun than learning alone at home from a book. Any skill acquired by one student would eventually be picked up by the others. When one student learnt to use animations or load songs into the e-lessons, others would crowd around to see how it was done. Younger students would also observe and learn from their senior schoolmates, creating a mentoring process on the spot. They learnt far more from one another compared to learning from the teachers.

The Malaysian Ministry of Education started to encourage teachers to enrol in ICT-related courses in 2001.This has paved the way for teachers to be proficient in using ICT sufficiently to train their students. Without such opportunities, it is unlikely that SPTS would have accomplished these results.

Nevertheless, there were several constraints to this approach. The availability of time and place to train the students was the biggest issue for SPTS, especially when considering the overcrowded classrooms and heavy workloads. It took time and energy to mentor the students, get to know them, interact with them and evaluate their work. Time was also needed to troubleshoot and correct their misconceptions, train them to use the apparatus and ICT tools, and guide them in enhancing their materials and slides. Patience and time were also necessary for listening to their presentations and helping them to hone their communication skills.

Computer labs equipped with the necessary software and hardware, and with good internet access were necessary to provide the space and facilities for the teachers and students to work together. If the schools lacked such facilities, then alternative arrangements and venues, such as internet cafes or working at home, would have to be worked out. At the same time, to keep up with the rapid development of technology, the teachers and students had to upgrade their ICT knowledge and skills continuously, and incorporate them into the e-lessons.

More importantly, in addition to their regular class work and assignments, the student teachers had to prepare and teach their peers. This also involved juggling their teaching schedules to minimize the disruption to the school's pre-set timetable. Unavoidably, the student teachers had to miss some of their own classes to do so, and they were personally responsible for catching up with their own work.

Conclusions

It should be noted that SPTS, when incorporated into the school system, is just one approach among many to help students learn and enjoy learning. The development of the student teachers – academically and personally – has provided convincing evidence to support the use of SPTS in schools. Likewise, their peers have also benefitted from this innovative approach to teaching, a fact substantiated by their enjoyment, enthusiasm and improved examination results.

Relying on students to teach their peers by no means repudiates the role and duty of the teacher. In fact, the teacher, as a mentor and trainer, bears a heavy responsibility to ensure that the student teachers first understand the concepts of the lessons themselves, and in turn impart the right instructions and explanations to the student learners. Similarly, the teacher has to guide and monitor the students in using the computer and internet to prevent access to inappropriate websites and content, illegal applications and practices, and abuse by faceless prowlers and criminals.

Obviously for SPTS to succeed, teachers must be willing to practice a student-centred approach to education and be provided with the necessary training – particularly in ICT knowledge and skills. There must be appropriate technology and infrastructure support for the teachers and students to implement the strategy. Collaboration among the various departments and classes in the school is essential. Finding a suitable period in an already overloaded timetable for student teachers to prepare and teach their e-lessons is equally crucial – the interval after the year-end examinations or a school break appear to be most convenient since the students will have more time to work on their presentations. Authorities should also give due recognition to student teams and teachers who have contributed significantly to develop SPTS.

One entry point to entrench SPTS in the curriculum is to assimilate the PowerPoint lessons and peer teaching exercises into the school-based assessment projects. The Malaysian Examination Syndicate has empowered me to give marks for Peer Teaching in Physics at O-level (Form 5) under the Evaluation for Practical Work in (PEKA). The impact of SPTS as a project-based learning approach will increase if other subject teachers receive similar empowerment from the Malaysian Examination Syndicate for the Form 3 public examinations and O-levels.

The students' experience in uploading and sharing the e-lessons through the internet highlights a practical and useful outcome of SPTS. As the materials grow in volume and quality, teachers and students all over the world will be able to add and refer to them for information and ideas. However, this means that other educators and their student teams have to be willing to share their lessons to build up the storehouse of good e-lessons. Furthermore, if high quality videos demonstrating how the students teach their peers can be produced and uploaded to websites, then others will be able to understand and use the same concepts and mechanisms of SPTS. Currently, the students' skills in videoing their teaching sessions are still developing; they require better equipment and more professional training.

The success of SPTS is not just a measurement of improved grades. Rather, it lies in its potential to encourage higher order thinking, independent learning, creativity, team work, confidence and communication. The impact of SPTS will lead to holistic learning both in and out of the classroom, for life.

As Whitman (1988) noted, "higher education research on peer teaching/learning indicates that, not only the peer learner, but also the peer teacher (tutor) experiences significant gains in learning as a result of their collaborative interaction."[2]

2 Whitman, N. A. 1988. *Peer Teaching: To Teach Is To Learn Twice*. Ashe-Eric Higher Education Report No. 4, 1988. Washington, DC: ERIC Clearinghouse on Higher Education, George Washington University and Association for the Study of Higher Education.

Annex 1: Example of an Activity Sheet on Archimedes Principle

1. In the experiment where 2 eggs are placed in different solutions, state the

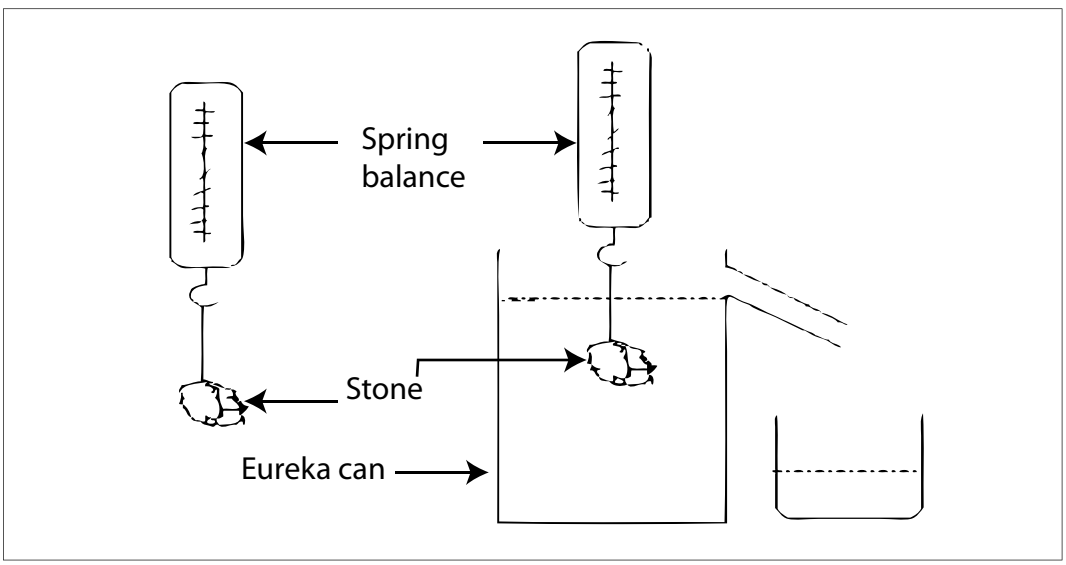
   a. manipulative variable .....
   b. responding variable .....
   c. fixedvariable .....

2. Why are people able to float in the Dead Sea?

   .....

3. Experiment: Archimedes Principle

   Objective: To verify Archimedes Principle
   Apparatus: 1 Eureka can
   2 beakers
   1 measuring cylinder
   1 spring balance, slotted weights on holder string and scissors



Procedures:

a. Set up the apparatus as shown above.
b. Fill the Eureka can with water to the brim.
c. Place the Eureka can at the edge of a sink.
d. Allow the water to naturally drain away into the sink until the water level is below the spout.
e. Attach the stone to the spring balance and record the stone's weight in air: W1 = ...

f. Lower the stone into the Eureka can until it is fully immersed without touching the bottom of the can.
g. Collect the water displaced in a measuring cylinder. Record the volume: V =……..……
h. At the same time record the weight of the stone while it is still fully immersed in water: W2. =…….
i. Record the amount of water displaced from the Eureka can: V= ……
j. Compare the weight of water displaced with the weight loss of the stone as recorded by the spring balance: W2 - W1 = ……
k. Draw a conclusion from the experiment.

Conclusion:……..……

4. What is the formula for Archimedes Principle……..……..……

Use the formula to state Archimedes Principle……

5. State 3 ways to increase buoyant force. ……

6. Hot air balloon questions

a. State two characteristics for material suitable to construct a hot air balloon.

……

b. What is the best time to launch a hot air balloon? Why?

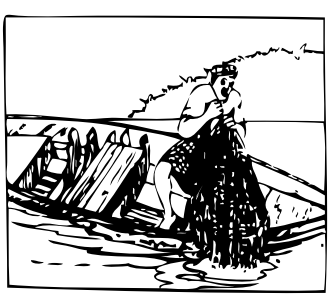
……

7. How is Archimedes Principle related to the working principle of a submarine?

……

8. A fisherman lifts his net which is full of fishes slowly out of the water. Observe the above pictures and state what happens as the net is progressively lifted out of the water. Why does this happen?





O-level calculations questions on Archimedes

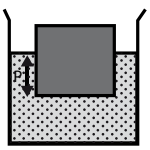
1. A piece of metal with the volume 0.002 m3 is immersed fully into water. If the density of the water is 1000 kgm-3, the buoyant force acting on the metal is:

   A: 40N B: 30N C: 20N D: 10N E: 5N

2. An object with a mass of 2 kg and a density of 8 x 103kgm-3 is immersed in sea water with a density of 1.03 x 103 kg m-3.

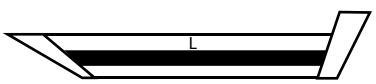
   a. What is the volume of sea water displaced?
   b. What is the buoyant force?
   c. What is the net upward force?

3. A cuboid with a mass of 0.12 kg is placed in a beaker containing water of density 1000 kg m-3. If the cross sectional area of the cuboid is 0.001 m2, what is the value of P if the cuboid sinks in the water?



   A: 0.0 8 m B: 0.10 m C: 0.12 m D: 0.18 m E: 0.20 m

4. A sampan has a safety limit L as shown in the above diagram. The volume below the line L is 4 m3. The mass of the sampan is 200 kg. If we wish to use the sampan and observe the safety limits, what is the extra maximum mass that can be supported by this sampan? (Density of water = 1000 kgm-3)



   A: 2.0 X 10^3 Kg B: 3.8 X 10^3 Kg C: 4.0 X 10^3 Kg D: 4.2 X 10^3 Kg E: 5.0 X 10^3 Kg

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