LEARNING MATHEMATICS VIA ICT INTEGRATION IN VALUES-BASED WATER EDUCATION

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Abstract

In our country where water is in abundance, society tends to take for granted that whatever happened in countries with water shortages are not their concern. But if we were to scrutinize our situation here, we will notice that the effects of water shortage in these countries are slowly creeping into our country as a result of human indifferences and industrialization. Apart from increasing our standards of living, industrialization also brings about air and water pollutions. All in all if we analyse the situation we will notice that all these problems arise because of the indifference of people lacking the 5 core elements of human values, that is, right conduct, peace, truth, love and non-violence. Seeing the importance of the roles of educators towards Education for Sustainable Development (ESD), a cooperation project on promoting 'Human Values-based Water, Sanitation and Hygiene Education' (HVWSHE) in Southeast Asian Schools was initiated by the SEAMEO Secretariat and UN-HABITAT. A regional Training of Trainers (TOT) course on the integration of HVWSHE was held in RECSAM from May 16th to 25th, 2007 as one of the capacity building initiatives to train teachers on the integration of HVWSHE with conceptual understanding of its philosophy, exemplary practices and its integration into mainly Science, Mathematics and Social Science curricula. After attending a few sessions of the HVWSHE course, the first author was inspired to plan a values-based Mathematics lesson via ICT integration to teach directed number involving "computation of integers and decimals using addition, subtraction, multiplication and division". A teaching try-out with Form 2 pupils in a secondary school in Penang was also implemented. The idea of "water rationing" was incorporated in a Mathematics lesson via Problem-based Learning (PBL). The students were confronted with a real life problem which they needed to solve immediately in order to survive with limited water supply. By using a spreadsheet program as ICT tool, the pupils were guided to work cooperatively and role-play as families to decide the amount of water they need per day. Several guided attempts led them towards better solutions. The teachers provided scaffolded activities incorporated with human values to help them learn about facts and figures. The pupils explored the concepts of directed numbers in a very contextual and meaningful way. The activities elicited higher order thinking with 5 core human values being integrated subtly in the lesson plan so that the pupils would raise the issues through their discussions in the process of solving real-life problems. Pre-/post-test questionnaires using 'Water Attitude Scale' (WAS) (Yeap, Ng, Wahyudi, Cheah & Robert Peter, 2007) were also administered to evaluate the impact of VBWE on students' sustainable water

use ethics and the findings were disseminated in an international conference (Ch'ng, Tan, Ng, 2007).

Introduction and Rationale

Our societies are faced with incessant problems that need to be solved every day. Although the advent of scientific and technological advancement has resulted in the improvement of the quality of living, some of the excessive developments and harmful scientific and technological inventions have also resulted in the imbalance of our ecosystem which threatens the Earth's life systems. A significant example is industrialization that brought about the many changes in environment and society. Apart from increasing the standards of living, it also created various side effects, for example air and water pollutions. Air pollutions with the emission of sulphurous gas and nitrous gas will eventually falls back to the earth as acid rain. Acid rain again brings with it a host of many other problems. We often read of irresponsible people dumping rubbish into the rivers. Industries and factories are also pumping toxic wastes into the river in great quantity. The contamination of water has caused much problem to the living things and the environment at large.

In our country, where water is in abundance, society takes for granted that whatever happened in countries with water shortage are not their concern. But if we were to scrutinize our situation here in Malaysia, we will notice that what is happening in countries with water shortage is slowly creeping in as a result of human indifferences and industrialization. Lately, it was reported that one of the contractor of a water treatment organization did not treat the sewage water well and as a result untreated sewage water spilled over to the nearby rivers affecting the livelihood of many villages living along the river. Toxic waste and rubbish dumped by people who lacks human values flow along the rivers, some seep into underwater streams and are absorbed by plants, while some are consumed by villages with the rest are ingested by fishes which in turn are taken up by animals and humans higher in the food chains.

All in all if we analyse the situation we notice that all these problems arise because of indifferent people who lack the 5 core elements of human values. Although governments of various countries have put in efforts through numerous technical and regulatory measures aiming at improving quality water management and distribution, the implementation of such measures cannot be accomplished without advocacy, awareness and educational initiatives. The World Commission on Environment and Development (1987) argued that,

> "…the world's teachers ... have a crucial role to play in helping to bring about 'the extensive social changes' needed for socially and ecologically sustainable environments…"
>
> (Fien, 1995, p.xiv)

Seeing the importance of the roles of the educators towards Education for Sustainable Development (ESD), the cooperation project on promoting 'Human Values-based Water, Sanitation and Hygiene Education' (HVWSHE) in Southeast Asian Schools was initiated by the SEAMEO Secretariat and UN-HABITAT. The rationale of HVWSHE is to inculcate the human values into the lives of our children from young so that they will be more caring and responsible adults. This project aims to support the fulfilment of Millennium Development Goals (MDGs) set by the United Nations towards achieving sustainable water-use ethics.

Objectives and Overview

A regional Training of Trainers (TOT) course on the integration of HVWSHE was held in RECSAM from May 16th to 25th, 2007 as one of the capacity building initiatives to train teachers on the integration of HVWSHE with conceptual understanding of its philosophy, exemplary practices and its integration into mainly Science, Mathematics and Social Science curricula. After attended a few sessions of the course, the first author was inspired to plan a human values-based Mathematics lesson to teach directed number involving "computation of integers and decimals using addition, subtraction, multiplication and division". This article outlines the preparation and implementation of a mathematics lesson via ICT integration to promote Values-based Water Education (VBWE). The lesson plan was pilot-tested at one local secondary school during the TOT course. Pre-/post-test survey questionnaires using 'Water Attitude Scale' (WAS) (Yeap, Ng, Wahyudi, Cheah & Robert Peter, 2007) were also administered to evaluate the impact of VBWE on students' sustainable water use ethics and the findings were disseminated in Ch'ng, Tan and Ng (2007).

Literature Review on Framework of Practice

Over 1.1 billion people in the world today lack access to safe water supply, and 2.4 billion lacks adequate sanitation. Approximately 84% of these people are in rural areas; however these problems are slowly creeping into the urban areas including Malaysia. The health hazards related to this lack of safe water and proper sanitation are endemic in many parts of the world, resulting in 2.2 million deaths per year from water related diseases, such as diarrhea alone, mostly among children. The economic impact of the lack of safe water and adequate sanitation is enormous, reinforcing the poverty cycle in a multitude of ways such as reducing the time available for income-producing activities.

Learning mathematics via cross-curricular approach integrating values-based water education

What are the long-term measures to alleviate water-related problems faced in the society? It is believed that prevention is better than cure. As the major damage of the water resources is caused by human beings, the crisis can thus be possibly alleviated in the long run by inculcating human values in basic education. The rationale of Human Value-based Water, Sanitation and Hygiene Education (HVWSHE) is to inculcate human values into the lives of our children from young so that they will grow up to be more caring and responsible adults.

Literature revealed that the integration of human values in all subjects and activities could be achieved via various direct and indirect approaches (Jumsai, 2003). Seetharam and Seetharam (2005) suggested that HVWSHE could be introduced indirectly via integrating values via cross-curricular approach or across the curriculum in all subjects such as science, mathematics and social science. This was reflected in the lesson plans of "Values Integration Developing Young Adults" (VIDYA) in the subject areas incorporating strategies such as discussions, debates, role-play, reporting, games, interviews, charts, to name a few (Seetharam & Seetharam, 2005). HVWSHE aims to change the attitudes of the people to value water and live with peace. The following are the 5 core elements of universal human values (the HV part of HVWSHE):

(1) "Right conduct", such as "Cleanliness, Conservation, Courage, Dependability, Duty, Ethics, Goal setting, Good behaviours, Gratitude, Healthy living, Initiative, Leadership, Obedience, Protection, Resourcefulness, Respect, Responsibility, Team work, Will";

(2) "Peace", including "Attention, Calm, Concentration, Dignity, Discipline, Focus, Happiness, Humility, Inner silence, Self-acceptance, Self-confidence, Self-control, Self-discipline, Service";

(3) "Truth", encompassing "Accuracy, Curiosity, Discrimination, Equality, Honesty, Integrity, Intuition, Memory, Quest for knowledge, Reason, Self-analysis, Self-awareness, Self-knowledge, Spirit of inquiry, Synthesis, Truthfulness, Understanding, Wise and efficient use of resources";

(4) "Love", such as "Caring, Concern for others, Consideration, Dedication, Devotion, Empathy, Friendship, Helping, Patience, Sharing, Sincerity, Tolerance"; and

(5) "Non-violence" including "Appreciation, Appreciation of other cultures and religions, Awareness, Brotherhood, Caring for all life, Citizenship, Concern, Cooperation, Loyalty, Minimum (natural) awareness, Social justice, Unity, Universal love, Unwillingness to hurt".

(United Nations Human Settlements Programme, 2006).

Problem-based approach integrating ICT with assessment/evaluation of learning outcome

In brief, the lesson design incorporating problem-based learning (PBL) approach integrating Information and Communication Technology (ICT) include the following (Ch'ng, et al., 2007):

1. The teacher could create a context with problem-based scenario e.g. water scarcity in a village and the possibility of threatening the life of the villagers. He/she may play the role as facilitator and would showcase when the needs arised. As this study is anchored on social constructivist perspective, the teacher could provide participatory or social learning opportunities through cultural scaffolding. The emphasis should be on the use of tools in mediating learning that might bring about changes in its underlying values, beliefs and culture (Ng & Fong, 2004).

2. The students could explore the learning issues in groups, integrating their knowledge into the context of the problem. For example, they were to explore how to ration water using mathematical thinking, decision making and computer skills (such as use of spreadsheet Excel programme) so that other people could have a fair share of the limited water supply. Finally they could summarize their findings incorporating mathematical thinking skills and computer skills, with evidences of their enhanced human values.

3. Evaluation of the outcomes of learning could be carried out using alternative assessment techniques. The assessment regime or method for HVWSHE is based upon multiple kinds and sources of evidence Observation will be made on behavioural changes; data will be gathered through interviews, questionnaires, checklists and record keeping; and assessment will be made on students' output of learning; to name a few. Information could be obtained about students' progress towards the desired outcomes of 'knowledge, skills and values/attitudes' contributing to continued learning as well as attitudinal or behavioural changes. Students' achievement will be reported and planning for further improvement of learning will also be made.

Sample Lesson and Implementation Procedures

Lesson plan illustrating the application of principles of constructivism in the classroom with reference to the teaching of mathematics via ICT integration

(1) **Title of the lesson:** How much water should we use?

(2) **General objectives:** This lesson is planned for Grade 8 or Form 2 secondary students to learn mathematics via constructivist, contextual (e.g. problem-based learning), cross-curricular (e.g. integrating mathematics with science and moral or civics) teaching approaches integrating ICT (e.g. use of spreadsheet MS-Excel). The students will be introduced to the core learning areas of mathematics subject on "**Directed numbers** (combined operations of addition, subtraction, multiplication and division of integers)" in relation to facts about water expressed in numbers, percentages and fractions. Various lesson sequences will be delineated incorporating pedagogical content knowledge with the aims of inculcating human values and enhancing sustainable water use via problem-solving in daily life.

(3) **Learning outcomes:** At the end of the lesson, the pupils should be able to:

1. develop a sense of duty or responsibility for sustainable water use ethics. They should realize:
- that sustainability can be achieved if human values are internalized.
- the importance of conserving precious water (truth) with elicitation and integration of human values related to "Water, social equity and human dignity", e.g. willing (love) to share (right-conduct) water supply in order to maintain peaceful relationship (peace and non-violence).

2. realize that human beings are the main agents causing the scarcity and depletion of water and they have the power and means also to conserve or prevent it. They should understand:
- the percentage of water covering world surface and the amount of water in living things.
- the interrelationships of water with all living things in the environment and society with various socio-cultural issues and problems.

3. develop a sense of accountability to avoid misuse and unsustainable consumption of water. They should understand:
- that mismanagement of water rationing can lead to serious consequences and
- mathematics could be applied to help water-related calculation and seek possible solutions.

4. refocus their perspective concerning water usage in daily life. They should consolidate their understanding:
- on various units used in daily life (e.g. mm, cm, inches, litres, ml, minute, hours, decimal places, to name a few) especially related to mathematical computation/calculation of water household consumption and water collected from rain or various catchment areas.

5. be transformed with a behavioural or character change towards self-management concerning the use of water. They should be able to:

- do a simple water-related project and through it demonstrate understanding of mathematical concepts and manifested inherent human values.

(4) **Target audience:** Grade 8 of Form 2 secondary students (ages between 13 to 14 years old)

(5) **Prior knowledge:** It is reasonable to assume that these groups of upper primary or lower secondary students already have the following skills as they were covered in the primary school (CDC, 2002; CDC, 2003a; CDC, 2003b; PPK,2001):

(a) "Numbering" in Primary 1, 2, 3, 4, 5 (up to 1 000 000).
(b) "Addition (A), Subtraction (S)" in Primary 1, 2, 3, 4 (highest total or within range of 10 000).
(c) "Multiplication (M), Division (D)" in Primary 1, 2, 3, 4 (within 2 to 9 timetables, highest product or dividend of 100 000).
(d) "Time and period" in Primary 1, 2, 3, 4, 5 (with understanding of the relationships between units of time, A, S, M and D).
(e) "Money" in Primary 1, 2, 3, 4 (with A, S, M and D up to RM10 000).
(f) "Fractions" in Primary 3, 4 (with addition and subtraction); also "Relate fractions and decimals to percentage" in Primary 5.
(g) "Decimals" in Primary 4 (with number to 3 decimal places and A,S,M,D until 2 decimal places)
(h) "Understand the relationship between units of time and between units of length" in Primary 5.
(i) "Measure and compare volumes of liquid using standard units" in Primary 5.

(6) **Procedure with assessment/evaluation of mathematics lessons via ICT integration:**

Estimated time: 90 to 120 minutes (in 2 to 3 sessions of 40-45 minutes each with flexible hours allocated for enrichment activities as take home project or Maths club activities)

6.1 Proposed steps in the presentation of the lesson with (a) estimated timeframe and (b) learning activities or teaching pedagogies to engage students

The suggested lesson steps are summarized in **Appendix I**. The PowerPoint slides used are listed in **Appendix II** while the Summary of Activities written on the chalkboard are presented in **Appendix III**.

The teaching and learning style emphasizes collaborative and cooperative learning. The students are divided into groups with the final and clearer answers expected to be obtained collaboratively and cooperatively. The questions posed require the students to solve the problem through role play and by imagining a certain scenario. Problem based learning (PBL) is used which require the students to seek a suitable amount of water to use, emphasizing human values. The teacher also employs contextual learning when a bucket of water of a certain liter of water is shown to the students to facilitate the amount of water per bucket. Integration of ICT like Excel and PowerPoint makes the lesson more interesting and accurate.

6.2 Assessment/evaluation activities by the teacher or instructor

The suggested Assessment Sheet to be distributed at the end of lesson is attached in ***Appendix IV***. Basically two types of assessment/evaluation activities will be implemented as follows:

(1) Assessment on **knowledge or skills** on Mathematical concepts via Q&A whereby students may also give examples from experience or calculations (refer **Appendix III** and **IV**). For example:

1. A rectangular tank, with dimension 10m (length), 8m (breadth) and 6m (height) is filled with rainwater to a depth of 3m. (*$1m^3$ water is equivalent to 1000 liters of water*). Calculate the *volume* of water in the tank.
2. The rate of evaporation of water from the tank is 0.002 liters per day throughout the week, and the villagers uses a total of 4 245 liters per day. Calculate the amount of water left in the tank after 3 days. (*Show your calculation steps*)

(2) Assessment on **manifested human values**:

1. Questions and answers during (a) class activities and (b) Pre-/post-test survey questionnaire which is the 'Water Attitude Scale' (WAS) (Yeap, et al., 2007) (Refer **Appendix V**). The findings were analyzed and presented in Ch'ng, Tan and Ng (2007).

2. Observation checklist on desirable human values to be inculcated and classroom activities.

3. Output of students' learning that include students' responses in the assessment worksheet and the feedback of their water-related project at home to demonstrate sustainable water use ethics (e.g. if they have carried activities to conserve water or harvest rain water).

Conclusion

It was a great learning experience for the authors to explore ways to educate the young people to value water through planning this piece of Mathematics lesson via ICT integration in values-based water education. Integrating a cross curricular lesson (with science and moral or social science subjects) into the classroom has been found to add value to a seemingly isolated discipline like Mathematics. From the tryout of this lesson in a local secondary school, it was observed that students found meaning in what they learnt as mathematics which was taught via the problem-based learning (PBL) approach had become alive and purposeful for them. Through interviews and analysis of pre-/post-test using WAS (Ch'ng, Tan & Ng, 2007), it was also found that students appreciated the learning experience and they would try their best to improve their water management by reducing water usage in unnecessary activities. It is hoped that the concerted efforts in mathematics learning via values-based water education could spearhead more initiatives to promote attitudinal change towards sustainable water use ethics.

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Appendix I

Suggested lesson steps for Mathematics via ICT integration in Values-based Water Education

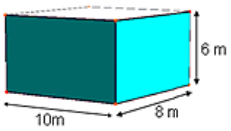
Subject matter area	**Mathematics via ICT integration**	**Time duration**
Topic (Sub-topic)	Directed Numbers (Combined Operations of Addition, Subtraction, Multiplication and Division of Integers.)	
Grade	8 (Form 2)	
Learning Outcomes	The students are able to: *1.* perform computations involving combined operations of addition, subtraction, multiplication and division of integers to solve problems. *2.* calculate the volume of a rectangular tank and to convert cubic meter to liters. *3.* use electronic spreadsheet (Excel) to determine the amount of water needed verses the number days the water tank can supply them water. *4.* list out at least 5 human values needed for them to survive and live peacefully in the community. *5.* suggest at least 5 ways they can do to save water.	
Human values addressed	*1.* Consideration for others *2.* Discrimination between right and wrong *3.* Respect for others' need in a community. *4.* Develop a sense of duty and responsibility for the sustainable water use ethnic.	
Lesson objectives	By the end of the lesson, students should be able to: *1.* appreciate water as an important commodity to life. *2.* treat everybody fairly for a peaceful community. *3.* calculate the amount of water left in the tank after a certain number of days *4.* act wisely and not to take things or situations for granted.	
Materials needed	Computer with Excel and PowerPoint, LCD projector, a bucket, 10 liters of water, and whiteboard with whiteboard markers.	
Teaching and Learning Steps:		**90 mins**
Introductory or Motivational activities	*1.* The teacher shows some pictures of water tank, and informs the students that the water tank they are going to consider is rectangular and has no covering. (Refer **Appendix II** for **PowerPoint slides**) *2.* The teacher asks the students to consider a hypothetical situation whereby the frequency of heavy rainfall in their area is low. *3.* The teacher asks some students to role play as father, mother, and	10 mins

	as children in a small community that experiences water shortage. 4. The teacher elaborates that there is no real answer to this problem but only probable solutions. 5. The teacher reminds the students that they are to jot down their thoughts and answers.	
Lesson proper **Stage 1:**	1. The students are divided into groups of five, each representing a family in a small community. The father being the head of the family with the help of his family will help solve a given problem. 2. The teacher fills up a bucket with 6 liters of water for the students to visualize its content. 3. The students from each family are to imagine how much water per day they would need as individual in the family (Example: bathing, washing, watering the plants, washing the cars, cooking, and others.) 4. The father of each family will add up the total number of buckets of water for his family on a piece of paper. provided. 5. With the help of the electronic spreadsheet, they are to enter the total amount of water needed by their family (in the form of number of buckets used) in the spreadsheet. Each family will jot down on a piece of paper the amount of water left in the tank after 30 days.	15 mins
Stage 2:	1. The students are to evaluate their situations and to determine whether situation is wise or not. 2. The father of each family will report what they have jotted down to everyone in class. 3. The teacher asks whether they are enjoying the water used. 4. The teacher will add up their total water usage to show the actual water usage in the community and the results will be discuss with the students.	20 mins
Stage 3:	1. The teacher asks the students to go back to their groups and discuss amongst themselves concerning their water usage. 2. Each family must now plan properly how they can avoid unnecessary wastage of water. 3. The new total water usage is again presented to the teacher who will again show the actual water usage. 4. The process of stage 3 (1 to 3) may be repeated until a satisfactory result is noted. (Refer also **Appendix III** for sample activities)	5 mins
Closure	The teacher explains and reminds the students that they need to: 1. conserve water as it is an important commodity to life. 2. internalize human values in their lives for a sustainable community. The teacher praises the students because they have cooperated with	10 mins

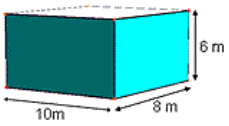
	each other and reminds them that cooperation is an important human value.	
Assessment/ Evaluation	The teacher gives each group two pieces of mahjong papers for them to: 1. show how they solve 2 mathematical problems 2. list out 5 practical **applications of core human values** to be internalized for an environmentally sustainable community. 3. reflect and list out **5 resolutions** they can make to minimize the consumption of water according to the human values that they have listed. (Refer also **Appendix IV** for sample) Their completed work will be pasted around the class for others to see and learn. (Teacher may also give water-based project as homework)	20 mins

Appendix II

Consider a water tank use for **rain harvesting** which has a dimension 10m by 8m by 6m



Let's say that a heavy rainfall can filled up the tank to 5m deep.
Usually, the rains comes every **2 weeks**.
Question:
How much water can the villages pump out water per day before the next rainfall?

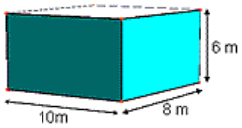


Since the rain filled up the tank to a depth of 5 m, the volume, V of the rectangle tank is

V = length x breadth x depth of water

$V = 10 \times 8 \times 5\ m^3$

$V = 405m^3$



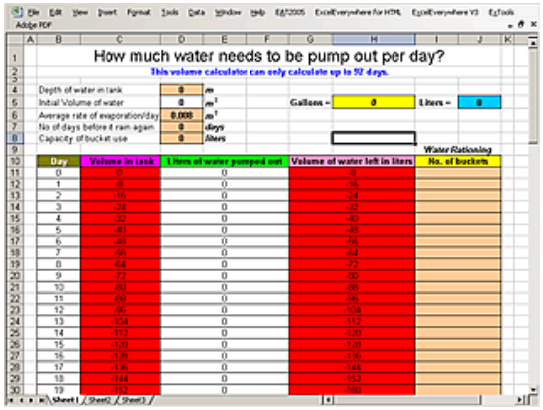
405 m^3 of water would be equivalent to 405 000 liters of water.
($1m^3$ = 1000 liters)

How many buckets of water must they allow each family to fill per day if they know that it is the next thunderstorm would most probably be 1.5 months from now.

Question 1

How many buckets of water must they allow each family to fill per day if they know that it is the next thunderstorm would most probably be 1.5 months from now.

There are 2 questions for the class to consider. The students will solve their problem with the aid of spreadsheet.



How much water needs to be pump out per day?

This volume calculator can only calculate up to 92 days.

Depth of water in tank	0	m			
Initial Volume of water	0	m^3	Gallons =	0	Liters = 0
Average rate of evaporation/day	0.000	m^3			
No of days before it rain again	0	days			
Capacity of bucket use	0	liters			

Water Rationing

Day	Volume in tank	Liters of water pumped out	Volume of water left in liters	No. of buckets
0	0	0	0	
1	-8	0	-16	
2	-16	0	-24	
3	-24	0	-32	
4	-32	0	-40	
5	-40	0	-48	
6	-48	0	-56	
7	-56	0	-64	
8	-64	0	-72	
9	-72	0	-80	
10	-80	0	-88	
11	-88	0	-96	
12	-96	0	-104	
13	-104	0	-112	
14	-112	0	-120	
15	-120	0	-128	
16	-128	0	-136	
17	-136	0	-144	
18	-144	0	-152	
19	-152	0	-160	

Table 1 for the students to fill and discuss in class

Table 2 for the students to fill and discuss in class

	Village 1	Village 2	Village 3	Village 4	Village 5
Initial volume of water in tank.					
No. of family in village					
Total liters of water used by village per day					
Total number of bucket per day.					
No. of days the tank can supply water to the village per day					
How much water will left in tank if say?					
If a villager cheated by pump up 5 buckets more water that allowed.					
No. of days the tank can supply water to the village per day					
How much water will left in the tank?					
Let say by the temperature in that area rise by 1°C					
No. of days the tank can supply water to the village per day					
How much water will left in the tank?					

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Village 1					
Village 2					
Village 3					
Village 4					
Village 5					

Appendix III

	Family 1	Family 2	Family 3	Family 4	Family 5
* Initial volume of water in the tank. * No. of members in the family * Total liters of water used by each family * Total number of buckets per day. * No. of days the tank can supply water to the villagers * How much water is still left in tank if any?					
If a villager cheated by pumping 5 buckets more water that allowed.					
* No. of days the tank can supply water to the villagers					

	Values 1	Values 2	Values 3	Values 4	Values 5
Village 1					
Village 2					
Village 3					
Village 4					

Appendix IV

Name of teacher : Mr. Ch'ng Yeang Soon

Grade/level : Grade 08

School : Sekolah Menengah (Agama) Al-Mashoor Lelaki

Subject Matter Area : Mathematics

Topic : Algebra (Volume of Shape)

Assessment Procedures: Group assessment

After the lesson, the teacher gives each group a few questions to answer. The questions are related to what they have learned and 'experienced' during the lesson.
There are two types of assessment given to the students.

1. **Verbal assessment** – when the students give 5 applications of human values that is necessary to promote harmony and sustainability.
2. **Written assessment** – when the students have to list out 5 resolutions or counter actions to conserve water so as to encourage sustainability and harmony.
   Students in project teams also need to mathematically estimate the number of buckets that each family should use and still have enough water left for emergency.

Assessment Questions

1. A rectangular tank, with dimension 10m (length), 8m (breadth) and 6m (height) are filled with rainwater to a depth of 3m. (*$1m^3$ water is equivalent to 1000 liters of water*)
   Calculate the **volume** of water the tank contains.

   Answer: ……***liters***

2. If the rate of evaporation is 0.002 liters per day throughout the week, and the villagers uses a total of 4 245 liters per day. Calculate the amount of water left in the tank after 3 days. (*Show your calculation steps*)

   Answer: ……***liters***

3. From your discussions, list out ***5 human values*** that you think are important or necessary to encourage harmony in your community or ensure the continual survival of your community.

a) Human values 1

_____

b) Human values 2

_____

c) Human values 3

_____

d) Human values 4

_____

e) Human values 5.

_____

4. What do you think would happen if ***human values are not shown*** in your community?

5. List out ***5 ways*** your family help ***reduce the amount*** of water use per day, based on the human values you have listed in *question 3*.

i) _____

_____

ii) _____

_____

iii) _____

_____

iv) _____

_____

v) _____

_____

Appendix V

Water Attitudes Scale

School: _____

Grade Level: _____

Gender: ( ) Male ( ) Female

INSTRUCTIONS

1. The rating scale is divided into four levels – "strongly disagree", "disagree", "agree" and "strongly agree".
2. Each statement refers to a certain attitude. Decide to what extent you agree with the statement. Put a (√) below the rating scale that best shows your feeling or opinion towards the particular statement.
3. Please respond to ALL items.
4. This is not a test. Your response will not contribute to the grades of any of your subjects. Please respond to the statements as truthfully as possible.

	Statement	Strongly Disagree	Dis-agree	Agree	Strongly Agree
1	It is alright to keep tap water running when brushing teeth				
2	Using high quality water or safe water for gardening is wasteful				
3	It is important not to dirty drains, rivers, lakes, sea, or catchment area				
4	I should report cases of water pipe leakage, water pump or any sanitation facility defects to my teachers or parents.				
5	I would report water theft if I see it				
6	Only people who cannot afford to pay water bill should try to save water				
7	I read books or follow news about water issues				
8	It is not necessary to discuss the values of water in school				
9	I like to share my knowledge about how to save water				
10	Water is cheap, we do not have to try hard to save it				
11	I have the responsibility to save water even there is enough for use				
12	I would like to participate in a water-saving campaign				
13	I would like to work together with others to clean wells, sinks or other sanitation facilities				
14	Maintaining cleanliness of the toilet is too difficult. I can leave it to my parents or family to do that.				
15	I would persuade others to save water even though I have to try very hard.				
16	Tempering with water meter is wrong.				
17	I appreciate the beauty of lakes, rivers and sea.				
18	Water cycle stabilizes our environment				
19	Water is important to health				
20	Since there is no shortage of water in my school or home, I do not have to take much care about saving				

	Statement	Strongly Disagree	Dis-agree	Agree	Strongly Agree
	water				
21	Supplying water to homes is the responsibility of the government only				
22	Even there is enough water now, we should save water for future use				
23	Rich and poor people should be charged the same water tariff				
24	It is important for girls to have proper water supply and sanitation facilities as for boys				
25	I often make facilities clean for the next users				
26	Cutting down too many trees causes more erosion.				
27	I like to walk along streams, rivers or beaches				
28	It is better not to report cases of water theft. One theft case does not cost much to the authority concerned.				
29	It is as important for the poor to have proper water supply and sanitation facilities as for the rich				