

AFFECTIVE LEARNING OPPORTUNITIES IN PRIMARY SCIENCE LESSONS

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Abstract

The first category of Affective Domain objectives in Bloom's Taxonomy is about "Receiving". In it, the first subdivision listed is "Awareness" (Krathwohl, Bloom & Masia, 1964). Since these categories are intended to be hierarchical in ascending order of internalization, it is important that young learners be given ample opportunities in their learning experiences in class to be *aware* of positive values and effective life skills. This paper presents pedagogical ideas to infuse affective learning activities into primary science lessons. Several concepts taught in the lower block (Primary 3 and 4) and upper block (Primary 5 and 6) science curriculum were identified for raising the awareness of values and life skills through an integration of cognitive-affective learning activities. The objectives of the activities are (1) to help learners understand or apply a taught science concept or skill, and (2) to use their newly acquired knowledge or skill as a prompt for them to reflect on some important positive values, attitudes or effective life skills. For example, a lesson on how a Plumb line is used in determining how vertical a tall structure (like a building or flag pole) is, may include an activity for students to reflect on why positive role models, like Thomas Edison or a caring close relative, are important in life. Eleven such activities have been crafted. The authors will share and demonstrate a sample of these activities that have been piloted with students from a primary school with aim of raising their awareness in positive values, attitudes and life skills.

Key words: Affective Learning; Life Skills; Primary Science Curriculum, Values, Attitudes

Number of words: 252

Strand 1: Teaching and learning science in formal setting(school)

Introduction

Education is often cited as a key area responsible for developing both individuals and societies to what they are today (Zimmer & Schunk, 2003). Much of the progress can be attributed to how we as individuals think, learn, apply and solve problems. As a community, people build on each other's knowledge and skills and hence create new knowledge and new skills that are supposed to improve the quality of our life. Learning to create new information and skills has been described in three distinct but closely related domains based on the learning outcomes for that learning experience. These are the cognitive, affective and psychomotor domains described by Bloom (1956) and widely referred to in all areas of learning even till today. Of these, the first and last domains are often dealt with effectively and efficiently in most educational systems. The affective domain, on the other hand, is not as easily handled by teachers in class because of the nature of affective learning outcomes (Krathwohl, Bloom & Masia, 1973).

Cognitive and psychomotor learning outcomes can be specifically expressed as behavioural statements. Action words are used in cognitive and psychomotor learning comes, like “ ..students should be able to ‘*state*’, ‘*explain*’ or ‘*perform*’...” to specifications described in the syllabus. These outcomes are behavioural in nature and teachers can assess students' performances quite effectively by comparing to model answers or acceptable performance standards. Students are also able to celebrate progress and improvement as they can see and experience for themselves the achievements they have made.

Affective learning outcomes are usually stated less concretely. Words like “*appreciate*”, “*aware*” and “*relate*” are often used in describing what students should be able to experience.

These words make assessment of affective learning outcomes more subjective and may require various modes of testing and judgments (Melton, 1997). This situation can lead to grey areas of assessment resulting in students' learning experiences in the affective domain being less impactful than in the other two domains.

Despite this comparison of learning experiences in the three learning domains, the importance of developing students' wisdom, and hence their mental maturity, in schools cannot be overlooked. Educational systems have an important role to play in the economic and technological progress but it can be disastrous if these same systems fail to develop people's attitudes and social behaviors at all or even positively. The Swiss National Centre for Competence in Research, (2009) noted that

“...*emotions and other affective phenomena* play a central role in human behaviour, both in a positive way, optimizing performance and well-being, and in a negative sense, encouraging violence and fostering psychopathology.”

Swiss National Centre for Competence in Research, (2009)

Popham (2010) in his book, *Everything school leaders need to know about assessment*, advocates the need for more attention on assessing students' affective learning outcomes.

“If educators care about students' *future* well-being, and few educators do not, then educators must be seriously attentive to students' current affect” (p.157).

It is therefore important for educators and policy makers to continue emphasizing the infusion of value education and the teaching of soft skills in school. Given the growing

concern about anti-social behaviours in societies and the frequent terrorist-related incidences globally, it is even more critical for teachers and governments to pay more attention to school-based learning experiences in the affective domain. Presently it is common to help students pick up values and good social behaviours by relying on positive peer pressure or modeling well-known figures with good backgrounds. These may be good approaches but leaving students to learn values and social skills by chance is just not an option because today our students have too many distractions. For example, apart from preparing for examinations, the high technology entertainment and communication gadgets will probably keep them very busy on a normal day. It will be difficult for them to focus their learning energy on the affective domain. Teachers, parents and educators will need to play a more active role to provide learning opportunities for their children to learn good social values and to develop positive learning attitudes and effective soft skills. To do these in school, there are two possible approaches: (i) to run programmes in schools that explicitly teach students how to be good and responsible lifelong learner-citizens, and (ii) to infuse affective learning opportunities into their cognitive and psychomotor learning experiences. There are already good efforts made with the first approach. This paper proposes a pedagogy using the second, to infuse affective learning activities into primary science lessons by teaching students science as usual in the classroom but lead them to surface positive values and social skills that can be illustrated by the concepts or skills they have just learnt or experienced.

The first category of Affective Domain objectives in Bloom's Taxonomy is about "Receiving". In it, the first subdivision listed is "Awareness" (Krathwohl, Bloom & Masia, 1964). Since these categories are intended to be hierarchical, in ascending order of internalization, it is important that young learners be given opportunities in their learning

experiences in class to be at least *aware* of positive values and effective life skills. Hopefully, the raised awareness will make a lasting impact on them even into their adult learning lives.

The Singapore Primary Science Curriculum

Singapore is sovereign city state since 1965. Having gone through 46 years of political, cultural and economic development, Singapore is still considered a young nation with little natural resources. About 4 million Singaporeans reside in modern and clean government-built apartments with many also owning private properties. The economy is strong and healthy. Singapore has a multi-racial and multi-cultural population comprising about 75% Chinese, 15% Malays and 10% Indians (Department of Statistics, Singapore, 2011). As an international business-financial hub, a global communication centre and a densely wired nation, Singapore has thrived very well over the last four decades. Today, like most educational systems in Asia (particularly in East Asia) the Singapore Education System is also frequently referred to as a good model for developing and developed countries. It has in recent years made numerous achievements in international studies in science, mathematics and the English Language (Barber & Mourshed, 2007; Boey, 2004; Dornan, 2008; International Alliance of Leading Education Institutes, 2011). Despite these good showings, the government and people of Singapore remain concerned about the intellectual, social and emotional well-being of the people and the survival of the nation. Hence, the Educational System is built around the mission of *Moulding the Future of our Nation* and visions like *Thinking Schools Learning Nation* and *Teach Less Learn More* are being realized in schools around the country (Ministry of Education, 2011a, 2011c; Ng, 2010). Teachers have also been encouraged to see their professional duties as a chance to *Lead, Care and Inspire* (Ho, 2009). All these are further supported over the years by the rolling out of ambitious learning

programmes to develop students' thinking skills and creativity, their social emotional learning experiences and also developing students' leadership skills and enterprise through co-curricular activities in schools where students participate in social learning and enrichment activities, the various uniformed groups and compete in various sports (MOE, 2011a).

Instructional programmes are also frequently revised and updated. The Science Education Curriculum Framework (Figure 1), for example, has been developed as the compass for all science syllabuses in Singapore schools (MOE, 2011b). The framework spells out the main areas of concern that school science need to focus on and the pedagogical and learning approaches students and teachers are encouraged to adopt.

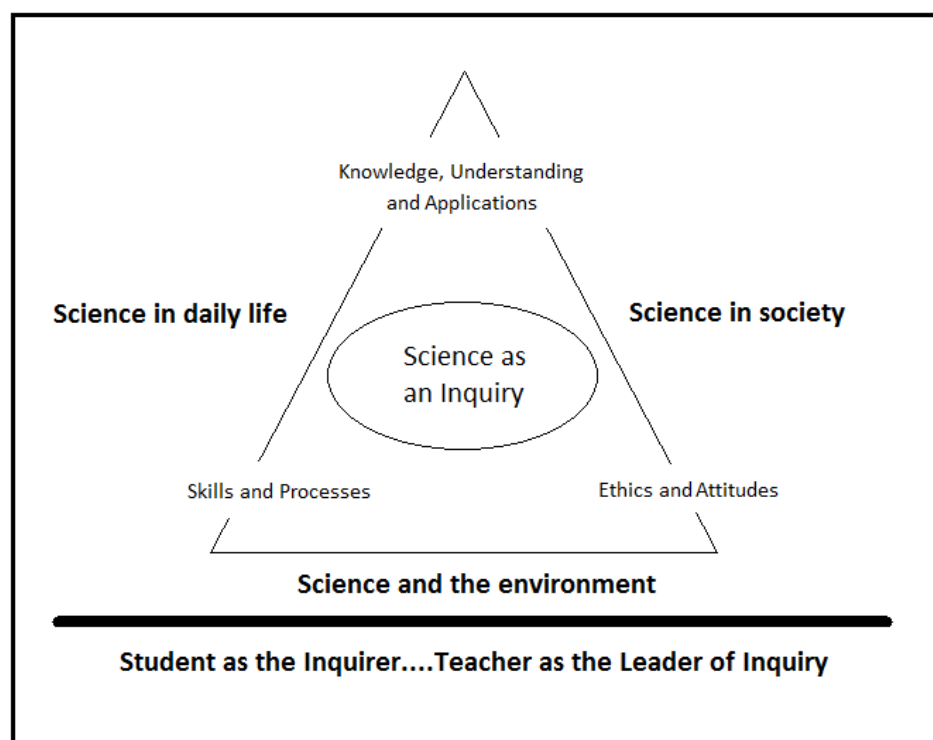


Figure 1. Science Curriculum Framework (adapted from original diagram, MOE 2011b)

Apart from the central “Science as an Inquiry” message, the 21st Century Competencies (Figure 2, MOE, 2011c), in the form of self-directed learning and inter-personal effectiveness

in collaborative and co-operative learning are also encouraged and emphasized throughout the various subject curricula.

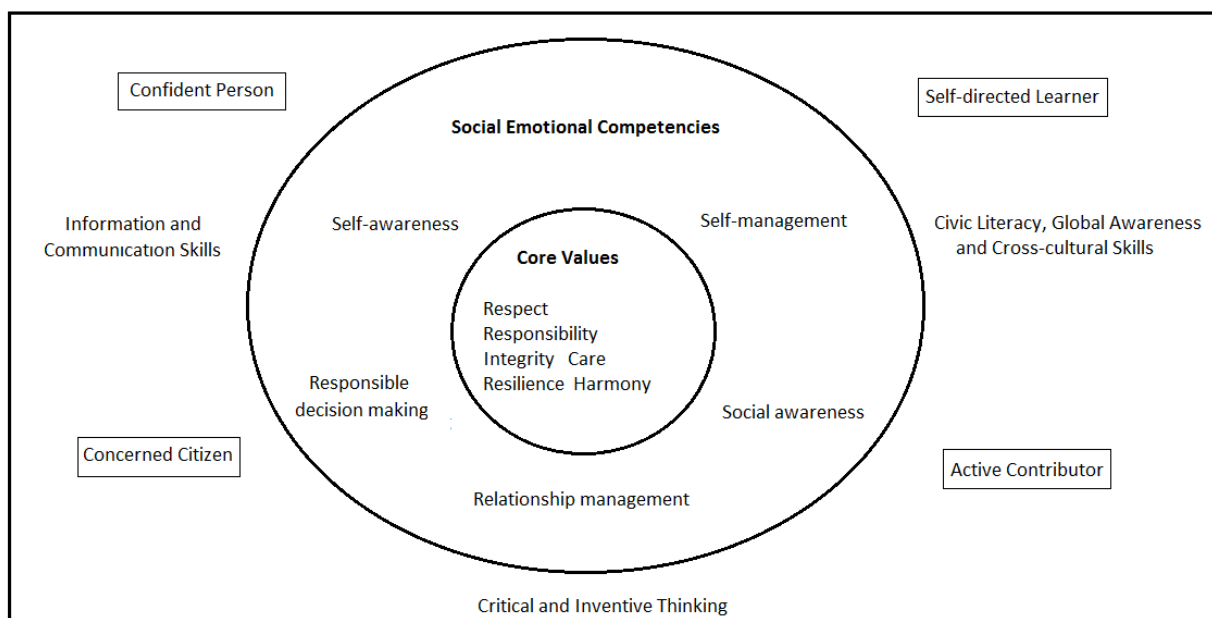


Figure 2. Competencies for the 21st Century (adapted from original diagram, MOE 2011c)

The Primary Science Syllabus (2011b) comprises five main themes, namely, Diversity, Cycles, Systems, Interaction, and Energy. Science is taught only from the third year in main stream primary schools. The topics in the five themes are typically organized in two blocks, the lower block topics are covered in Primary 3 and Primary 4, and the upper block topics are taught in Primary 5 and Primary 6. All topics in both blocks are assessed at the National Primary School Leaving Examination (or PSLE) before the students graduate to study in secondary schools.

The Primary Science Syllabus also has a broad range of carefully thought-out opportunities for students to experience learning in the affective domain. However, like most high-stake examination systems, students do not often take these learning opportunities as

seriously as they would those in the other two learning domains. As experienced and practicing school teachers, the authors are well aware of the very tight school time tables and the need for teachers to cover the examination syllabus as constraints. Besides, performance at the PSLE is critical to students who aspire to study at top secondary schools or to win scholarships and other academic awards. While success in academic performances is important to the academic and career future of the students, it is equally, if not more, important for them to be aware of good social habits and positive values that have always been supported by the various cultures in multi-racial, multi-cultural and multi-religious Singapore.

The school system has in place many affective learning programmes. These include Community Involvement Projects (CIP), the Social Emotional Learning (SEL) Programme and Co-curricular Activities (CCA) (MOE, 2011a). These programmes are commendable and have been effective in instilling in many students values like pride, responsibility and compassion. To further support these programmes, this paper proposes a strategy to infuse affective learning opportunities into the main instructional programme. That is, to help students surface and understand the importance of good social values, positive learning attitudes and effective soft skills while they are learning science concepts and process skills in class. The argument is that students are most likely to be attentive and serious about learning concepts and process skills that are assessed in examinations. While they are energetic and attentive, the teacher can lead students to reflect on what they have learnt about science and relate these knowledge and skills to personal life experiences or events that can be illustrated by the science concepts or skills they have just learnt. By doing so, students can surface values and soft skills on their own through a short reflective exercise or activity at the end of the lesson. Work in this area commenced in 2009 at the National Institute of

Education as an unfunded pedagogy-curriculum development initiative (Tan, 2009). In the past two years, three secondary school science teachers from two schools in Singapore had piloted the pedagogy with encouraging success (Tan, Heng, Lin & Tan, 2010). In the current discussion, we report a similar affective learning-infused science lesson piloted with a primary six class at a neighbourhood primary school in Singapore.

Infusing Values and Positive Social Habits in a Primary Science Lesson

The objectives of the activities in the affective learning-infused science lesson described in this paper are (1) to help students understand or apply a taught science concept or skill, and (2) to use their newly acquired knowledge or skill as a prompt for them to reflect on some important positive values, attitudes or effective life skills. For example, a lesson on the use of a plumb line to determine how vertical a tall structure like a building or flag pole is may include an activity for students to reflect on why positive role models, like a well known scientist or a caring close relative, are important in life.

In 2006, the main author published an article describing the efforts in bridging the cognitive-affective divide in Singapore' school chemistry curriculum (Tan, Goh & Chia, 2006). Interest in this area led him to propose affective learning activities for students in the secondary chemistry classroom and laboratories. In 2009, several secondary schools were approached to pilot these learning activities. Two schools volunteered and three basic chemistry lessons were taught to secondary 2 and 3 students. The participating teachers have reported very positively the responses of their students' learning experiences (Tan, Heng, Lin & Tan, 2010). These include students being more aware of their own personal, learning and social habits, and also the teachers' own admission about being able to know in-depth their

students' social and emotional learning behaviours. Several workshops were also conducted for pre-service and in-service teachers in Singapore and Hong Kong. Feedback from the participants has also been positive and encouraging.

This paper shares a primary science classroom lesson using the same approach: infusing affective learning opportunities while students are learning science concepts and skills in class. The one-hour lesson is for 37 Primary Six students (20 girls and 17 boys) at a government co-educational primary school sited in northern Singapore. The teacher, who is also the co-author, has more than 20 years of teaching experience. She is also the Lead Science teacher in her school. In this lesson, the students are taught the concepts of gravity and centre of gravity. The lesson is in line with the "Science as an Inquiry" approach as described in the science curricular framework. Through an inquiry approach involving questioning and group hands-on activities, the teacher introduced the concept of centre of gravity and shared with students how a plumb line can be used to determine how upright objects are or how level a ground is. Students were also given the opportunity to work in groups trying to find the centre of gravity of a cardboard cut-out of an object by using the plumb line. At the end of the lesson, students were evaluated on their understanding of the science concept and skills (as in the hands-on activity to find the centre of gravity of an object). Then, as a continuation of their learning, the last five minutes of the lesson was the focus of the affective learning experience.

Students' Responses to Learning Opportunities in the Affective Domain

The lesson started off as cognitive domain learning experience for the students. As the teacher questioned students' prior knowledge on the use of a plumb line and their

understanding of gravitational pull, the main author observed the behavioral and verbal responses of the students. The students were observed to be attentive, participative and in fact, quite inquisitive. The professional experience of the teacher effectively led students to learn what a plumb line is and the scientific concept behind its use to check the verticalness of an object. The students' knowledge and their ability to apply it were validated through their successful completion of the group hands-on activity. Towards the end of the lesson, the last five minutes, the teacher brought the students' attention to that of "a real life situation". She asked the question "Who are the plumb lines in your life?" Verbal responses from the students include "my parents", "my teachers", "good friends" and even "textbooks".

The partial transcript of the last five-minute affective-learning infusion science lesson is in Annex A and selected students' written responses to the worksheets (Annex B) are presented in Annex C.

Discussion

From the observer's professional experiences observing secondary school classroom lessons, it appears that primary school students' impromptu verbal responses to teacher-initiated questions are more easily solicited. Probably primary school students are more participative, less shy and more innocent than their older counterparts in secondary school. It is also possible that given their young age, they have less life experiences to fall back on hence when tasked to give examples they have fewer to cite. Thus, they readily cited the adults in the life, for examples, their parents and relatives like grandparents, uncles or aunties, their teachers or mentors in community organizations where their parents bring them to during weekend family-related activities. However, when given time to reflect (the

worksheet was given as a piece of homework), they could come up with an impressive list of examples and reasons for citing who they think are the plumb lines in their lives (Annex C).

On the lesson dynamics, it was observed that the lesson on the centre of gravity had just been taught. Students had in their young minds freshly minted knowledge and experiences from the hands-on group activity. The uses of the plumb line to check for *uprightness* of an object (pun intended) and to find the centre of gravity of an object where one can actually balance the object at the finger tip so as to understand the concept of *stability* (again, the pun is intended) are excellent opportunities for the teacher to help students surface awareness of the related positive social values (like being upright or being a good role model) and habits of mind (like being focused or finding a useful aim in life). Through the last five minutes, the class was actively engaged in discussing who are the “plumb lines” in their lives and why did they chose them (Annex A). The teacher also ended the lesson with a review of the concept of centre of gravity such that the students were able to conclude that having identified the centre of gravity on their cardboard cut-out, they could actually balance it steadily on the tips of their index finger. This was again used as an analogy for students to understand that they will find their life more meaningful and hence more stable if they can identify meaningful aims in their life.

The objectives of this trial lesson have all been successfully met. Further work is being planned to study the effectiveness of such science lessons both in primary and secondary schools in raising students’ awareness in the affective learning domain. There could be a huge gap in the knowledge base within this area of affective learning. Some possible areas include the development of pedagogy and curricular materials that may provide valid learning experiences to enhance students’ motivation and affective learning skills, for examples, in

being more curious and responsible or being more collaborative in group work. Also, in the assessment of affective learning outcomes, reliable measurement methods are probably lacking. If these gaps in the affective learning domain can be addressed by the educational research community, major improvements may be made in the ways subjects like science, mathematics and even the languages and humanities are taught such that students will be equally motivated to do well in all three learning domains.

CONCLUSION

This affective learning-infused lesson was an hour long but impressions from the learning experiences, both for the students and the teacher (including those of the observers' in class), are very likely to be lifelong. If students find the science concepts important (hopefully not just for passing and doing well in examinations) they are likely to also remember the affective messages appended to the lesson they had just attended. With more such exposures, the impact of learning in the affective domain over twelve years in school should not be any less than those in the other two domains

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Annex A: Partial transcript of the last five minutes of the affective learning-infused science lesson.

T: ...the last portion of your worksheet...it is actually about the ending of our lesson today. We've learnt about the plumbline and how they were able to use the plumbline to find the centre of gravity...

00:00¹

Manufacturers produce products with a broader base at the bottom. Why should they do that?

A tight rope walker walking on a tight rope, why does he hold a pole or an umbrella?

When you are on a boat, and you want to change place. You stand up and the boat will start to rock.

All these things have a connection to the centre of gravity.

T: Now we are going to move into something to do with the heart. What we have been doing (so far) has got to do with the head, the cognitive side, we called it. The affective side has to do with the heart.

01:05

Plumbline is use to find out if something is upright. So if you look at the question (in the worksheet), the next one, page 3. "What are some plumbines in your life that direct you to do the right things?"

Are we talking about the actual plumbline? We are connecting this to a lesson of the heart. Anybody wants to give an answer? What you think are some plumbines? What the reasons for (us to have) some plumbines?

S1: To balance all your kindness.

T: Ok, what do you mean by that? Do you have plumbines to help you do the right things? what are some of the plumbines in your life?

02:04

S2: Your conscience.

S3: People around you.

T: Yes, people around you. Can you explain further what you mean by people around you?

02:22

S3: Teachers, parents.

T: OK, teachers, parents. Why do you say they are your plumbines?

S2: Teach you to do the right things.

¹Note: Timing refers to the last five minutes of the one-hour lesson.

T: 02:43 What other plumbline do you have in your life? "Name of Student 4"...I heard something...

S4: "Name of Student 5" is my plumbline.

T: "Name of Student 5" is your plumbline. Can you explain further why he is your plumbline?

S4:(inaudible comment)

T: (repeating comment)..he always scold you when you do the wrong thing.

S4: Yah...

T: 03:17 So if "Name of Student 5" is your plumbline then he is a model student, right? Ok, let us go on to the next question. I want you to think about in what way is the plumbline like a model student who set good examples of conduct and behaviour? [Note: teacher meant how a model student is like a plumbline?]

S6: To help us to learn from them.

T: 03:46 To help us to learn from them right. Any other ways? Try to connect it with what you did today about the plumbline. [04:05: Bell rang to signal ending of lesson.] Yes "Name of Student 5".

S5:(inaudible comment)

T: 04:10 Very good, I like his answer. [Teacher help student to stand up and face the class.] Ok but you were not listening and he is going to tell you loudly.

S5: [Standing and facing the class.] Plumbline in your life is like our graciousness, our inner self. Someone who is a plumbline in your life will help you attain a higher position.

T: 04:51 Very good. [S5 returned to seat amidst clapping among classmates.] So I want you to go back home to think about what you have been doing today...in science, and to relate it to your life.

Science is about real life situations. It is about connecting things.

So think about it and write down your responses and I will get it from you on Monday.

[05:14 Lesson ended.]

Annex B: Lesson Worksheet

Title of Activity: “KEEPING THINGS UPRIGHT”

Background Information:

Definition: The Centre of gravity of an object is the point through which the total weight of the body can be considered to act.

Group activity in class

In your group, use the plumb line to find the centre of gravity for your aircraft (a cardboard cut out).

- (1) Punch 3 holes with the pin anywhere around the exterior parts of the planes.
- (2) Loosen the holes slightly with the pin so that the plane can hang loosely and freely.
- (3) Suspend the object to swing freely on the pin through one of the holes created.
- (4) Attach a plumb line to the pin (keep holding the plumb line with your finger) and draw the line on the plane using a ruler and pencil.
- (5) Repeat the same steps for the 2nd and 3rd hole.
- (6) Take turns doing the various steps.
- (7) Where the lines intersect, is the centre of gravity.

For class discussion: *Responses (Cognitive Domain)*

- (1) What force is acting on the plumb bob? Which direction is this force acting?
- (2) Were you able to find the centre of gravity for your plane? What precautions did you take to ensure good results?
- (3) Explain the reason/s for the following situations in relation to the centre of gravity.
 - (a) Manufacturers often try to make their products with the centre of gravity as low as possible. They do this by making the products heavy at the bottom and giving them a broad base. Why? Give 2 examples of such products.
 - (b) A tight rope walker often carries a weighted pole or an umbrella. Why?
 - (c) It helps in the designing of vehicles such as cars and buses by keeping their centre of gravity very low. This is done by placing the engine very low in the car. Why?
 - (d) It is dangerous for passengers of small boats to stand up in order to change seats. Why?

For class discussion and written homework: *Responses (Affective Domain)*

- (4) A plumb line is able to help us tell if a structure like a building is upright or not and to find the centre of gravity of things.
 - (a) What are some ‘Plumb lines’ in your life that direct you to do right things?
 - (b) In what way/s is a plumb line like a model student who sets good examples of conduct and behaviours to others?

[For responses to (4) (a) and (b), see Annex C.]

Annex C: Selected students' responses to affective learning task in worksheet

Title : "Keeping things Upright" (Plumb line & Centre of gravity Lesson)

(4) (a) What are some 'Plumb lines' in your life that direct you to do right things?

- Teachers, parents, relatives and good friends
- Elderly
- Our feelings and emotions
- My conscience
- Parents, teachers, friends and prefects help me in my life to direct me to do right things such as behaving myself in class, handing in homework punctually and making right decisions.
- Some good books that I have read
- Parents and teachers. They guide us almost half of our lives and bring us to the right path, leading to a bright future.
- Parents, friends and teachers. Whenever I do something wrong, they ask me to re-think if what I am doing is right and will benefit myself and others.
- Classmates
- My conscience and the good people around me keep me on the avenue of good and not on the streets of evil.

(4) (b) In what way/s is a plumb line like a model student who sets good examples of conduct and behaviours to others?

- The model students can make the bad students turn good and they will strive to achieve great things.
- A model student sets good examples which help to lead others to the right direction and not be influenced by wrong things.
- It is to balance our inner self, graciousness and kindness so that we make improvements to ourselves and the place around us.
- A role model for good conduct.
- To learn from these model students, correct myself when I am wrong.
- Influencing others to perform well.
- A model student will influence and be an impact to others.
- A model student teaches us self discipline as we try to follow good examples.
- A model student is not totally perfect but he is better in conduct and behaviour than others. A plumb line helps us tell if a structure is upright. Similarly, a model student helps other students by showing good examples to follow. My aspirations in life also act like the plumb line by showing that one can achieve anything in life if he believes in himself.
- A model student is a guide for others to follow.
- A model student shows the right way and a plumb line will help people measure things that are upright.

Note: Some of the selected examples above had been corrected for grammatical mistakes and sentence structures.