UNITE for the Environment

Solid Waste Management Training

3rd Term

2017

Training objectives: By the end of the training,

- Participants will be able to produce eco briquettes.
- Participants will be able to create learning objectives that focus on higher order thinking.
- Participants will identify the most appropriate waste management method applicable to their communities.

INTRODUCTION TO MAKING BRIQUETTES AND ITS RELEVANCE TO WASTE MANAGEMENT

What are eco-briquettes?

These are blocks of compressed biodegradable waste materials used as fuel for cooking.

Advantages of using briquettes.

- They help reduce biodegradable waste. Most of the raw materials used in making these eco-briquettes such as sawdust, peelings, and paper are wastes that are sometimes not put to use. Therefore using them in a productive form helps to address their accumulation as waste.
- Reduces deforestation. Many Ugandans use firewood or wood charcoal for cooking and heating and this has resulted in deforestation. However, individual households can reduce their need for wood products by making their own fuel while putting bio-degradable waste to use through producing eco-briquettes.
- They are clean and easy to handle as compared to charcoal.
- If well prepared, they produce less smoke.

Raw materials for making briquettes.

- Sawdust
- Cassava peelings/ flour
- Dry leaves
- Water
- Waste paper
- Maize cobs
- Banana and other peeling

Steps involved in handmade briquettes

1. Collect waste materials such as sawdust, banana peelings, dry leaves, and maize cobs charcoal fines and chopped grass.
2. Put the collected materials under the sun to dry.
3. These waste materials can be put in a container and half burnt/cooked.
4. Pound the half burnt mixed waste materials using or wooden mortar and pestle.
5. Soak torn-up waste paper in water to soften thoroughly (this can be done a day in advance), rub the soaked paper well between your hands until it looks like soft porridge and no pieces can be seen or boil cassava peels for 10- 15 minutes to make them very soft to form a porridge like paste which will be used to bind the waste materials together.
6. Measure out 1 part of soaked paper or cassava paste to 3 or 4 parts of waste materials.
7. Mix the paper or cassava paste with the pounded waste materials while still warm and enough water so that the mix will hold together when it is squeezed.

8. Make a bottle mold. Cut off the upper quarter of a 2L soda/ mineral water bottle or other straight-sided plastic bottle.
9. Make 10- 15 drainage holes in the bottom and lower sides by burning holes with a hot wire.
10. Prepare a thin plastic bag to use as a liner to get the finished briquette out of the bottle. Punch about 12 drainage holes in the bottom and lower sides of the bag so water can drain out.
11. Put a big handful of pounded waste and binder mix into the plastic bag and insert the bag into the bottle mold.

12. Add more mix to the bag and press out water with a can or with a piece of wood or banana stem that fits into the mold.

13. Put the mold on the ground or floor and stand on it to press out as much water as possible.
14. Pull the bag out of the mold and remove the briquette.

15. Dry the briquettes in the sun for 3-7 days. Briquettes that are not dry will smoke when they are burned, so dry them well!

NB .If you don't have a mold, you can make fuel balls by squeezing the briquette mix into balls with your hands.

SOLID WASTE MANAGEMENT ACTIVITY 1: Adapted from A-way with Waste: A Waste Management Curriculum for School, Department of Ecology, State of Washington.

Objective: To learn what recycling is and how it works in comparison to other waste management options. Students will consider the positive and negative aspects of recycling as a solid waste management option.

Background: One of the options of proper waste management is recycling. There are other options such as prevention, re-using, reduction, compositing, using incinerators and landfills.
The basic operating principle of recycling is processing waste materials into something useful. Recyclables may be separated out from non-recyclable waste by mechanical means. Non-recyclable waste should be composted, burnt in the incinerator or disposed of in a landfill.
Critics of recycling, however, raise objections such as the cost involved and the skills needed.
Procedure:

1. Define and discuss the following solid waste management options:

- Recycling: Processing waste materials that would otherwise become waste into valuable resources. E.g. processing banana peelings, off cuts and paper into briquettes.
- Prevention: The act of avoiding waste generation. For example going to a shop with your own bag to prevent shop keepers from packing what you buy in a plastic bag
- Reduction: Selective buying to aimed at consuming and disposing less waste or minimizing the quantity of waste you generate in your consumption
- Composting: Controlled biological decomposition of biodegradable waste, such as food and yard wastes into humus
- Incineration: Using facilities that are specially designed to aid in the burning of non biodegradable waste
- Landfills: Sites set aside to be used as dumping sites for waste
- Re-using: Using of what would have been disposed of as waste for any productive purposes. E.g. instead of throwing away a plastic water bottle, it can be used in collecting oil, paraffin and other liquid items from the shop

2. Research and discuss the advantages and disadvantages of each as per the list on the following table.

Option	Advantages	Disadvantages
Prevention		

Reduction		
Recycling		
Re-using		
Composting		
Incineration		
Landfill		

Remember that each community is unique and needs its own waste management plan.

3. After researching and discussing the options, put together a plan for your community, taking into consideration the following:

- Quantity of garbage produced.
- Type of waste produced.
- Population.
- Land available.
- The environmental effects of the disposal method.
- The cost implication of disposal method.
- Presence of materials that don't burn or are dangerous in landfills or incinerators.

4. To come up with a concise plan, ask:

- Which combination of options would best serve your community in the long term?
- Is any one of these options adequate on its own to handle your community's solid waste?
- If you were the community leader responsibility for dealing with solid waste, which options would you choose?
- Who in your local community makes decisions about the management of solid waste?
- After this exposure, you may want to get involved in your community's planning process.

Follow-up:
Organize a debate around two of the most relevant waste management options and call students, teachers, local community leaders and environmental groups for various points of view on this subject.

SOLID WASTE MANAGEMENT ACTIVITY 2: (Adapted from Earth Day 1990: Lesson Plan and Home Survey, Stanford University)

Concept: Stimulate thought on what we throw away.
Objective: To see what percentage of waste is packaging.
Materials:

- Examples of household waste items
- Paper , markers and pens
- Home recycling survey

Background: When most of us throw away waste, it usually ends up in our gardens. As a result, our soils are degraded, and every time we throw something away we throw with it the energy, the money, the raw materials, and the water it took to make it.

However, some of this waste material could be recycled. Recycling saves large amounts of energy and when waste products are recycled, fewer raw materials are used.

Procedure:

Collect a variety of household items that are thrown as waste. Try to include items which could be re-used such as plastic bags, water bottles, tins, and things which create "instant" waste such as leftover food, egg shells. Also include items which could be recycled, such as paper, banana peelings.

Introduce the option of reuse by displaying a variety of household items which are frequently thrown into the garbage but could be used for other purposes. Ask students to describe uses for each of these household products. Survey the class by holding up each item and asking for a show of hands if the item could probably be found in their garbage at home.

Tell the class that, in order to reduce the amount of garbage we produce, some of the items could be used again and some could be "replaced" at the shop by purchasing other products in the first place. For example, non-disposable items produce less waste than items made to be used only once. Explain to the students that when we use an item more than once (for the same or different use) we call it re-using while recycling is remaking a new product.

Students will take home a set of questions home recycling survey to be answered by them with guidance of family members.

Home Recycling Survey

1. Tick the items that go into your waste bin.

- Cans/tins
- Glass bottles
- Paper
- Diapers
- Plastic bags
- Paper bags
- Egg cartons
- Batteries
- Clothes
- Magazines

2. Which items (of those listed above) could be recycled by you or someone else?

_____

3. Is there any one in your village who recycles any of these items?

Yes ___ No ___ I don't know___

4. Where does your garbage go once it leaves your house? (Lower primary pupils can draw a picture and upper primary and secondary students can explain in words.)

_____

5. What are the benefits and challenges of recycling to your family?

Benefits:_____

_____

Challenges:_____

_____

7. How does recycling help the environment?

_____

_____

FOLLOW-UP:
Discuss the following questions:

- What items can be found in the garbage in most of our households?
- Are any of the items used again (reused) in most of our households?
- If so, what are they used for?
- Does our town have a place where people can take items to be recycled?
- If so, have any of you ever been there? What kinds of things did you take to be recycled?
- Where do most of the people we surveyed think our garbage goes once it leaves our homes?

ACTIVITY 3

You will need large container/containers to hold a week's worth of classroom trash, a large curd board box, large trash barrel or several plastic trash bags.

You will also need arrangements so that no one collects trash from the room during the week.

Procedure

1. Discuss with students whether it is really possible to throw something way. Where is "away"? Do these things somehow disappear? Can trash continue to affect us even when we have thrown it away?
2. Tell students that for one week, they will collect trash while in school. Explain that everything they want to throw away during the week should go into the large container/s you prepared earlier. Have them predict how full the container will be at the end of the week. You might also have them predict the types of items that will make greatest proportions of trash. Have students collect food waste in a separate container and weigh I before they throw it away each day
3. At the end of one week/ each day, have the students look at their trash. Did more or less waste accumulate than they had predicted? You can sort through the trash and hold items for them to see or you can have several students sort through the waste .Record on board the quantity and type of each
4. Older students can make tables, charts or graphs that show the number of pieces and types of trash collected. They can figure the percentage of categories of items e.g. paper, plastics etc
5. Discuss the following

- What usually happens to trash at the end of each day?
- Where does trash end up?
- How often is it picked up from the waste bin, and after does it go to compost pits, incinerators or?
- What are the advantages and disadvantages of incinerators, compost pits etc
- Where do materials come from to make items in the trash e.g. paper comes from trees, metal cans from minerals , plastics from fossil fuels, etc
- When people use things only once and then throw them away, what are the effects on our supply of natural resources? (We have to use more natural resources and fossil fuels to create new products).

6. Have the students look at the list on the board and try to think of what they could do to keep some items out of the trash and therefore out of the landfill or incinerator. As you go through the list, ask the students to think of ways they could reduce, re-use or recycle each of the items on the list while giving examples.

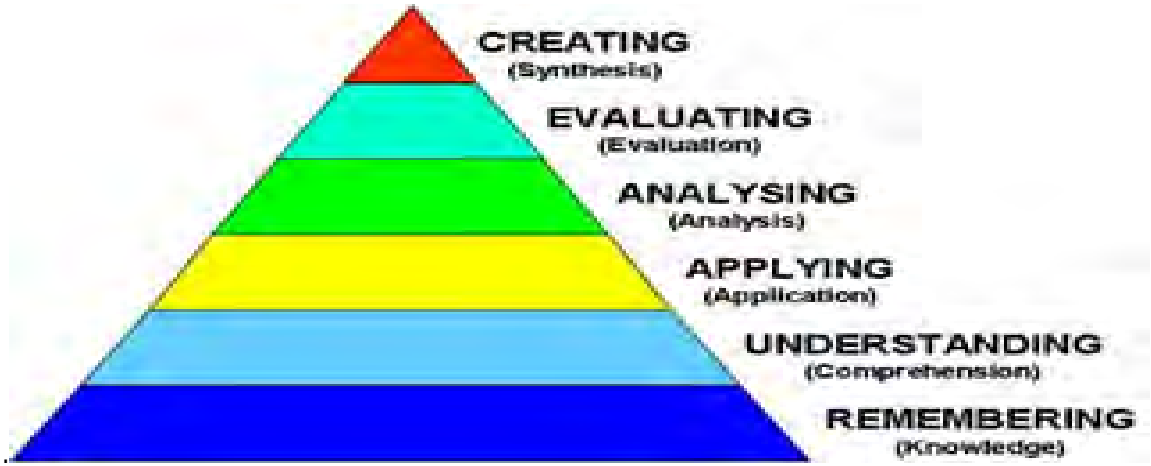
LESSON DEVELOPMENT (HIGH ORDER THINKING AND LOW ORDER THINKING IN TEACHING)

What is high order thinking and low order thinking in teaching?

Lower order thinking is the foundation of learning skills. These are skills that are taught very well in schools through reading, writing reciting, defining. Higher-order thinking is a concept of education reform that requires more reasoning. It involves the learning of complex judgmental skills such as critical thinking and problem solving. Higher-order thinking is more valuable because such skills are more likely to be applied in different situations.

Advanced forms of higher-order thinking may not be applicable for a pre-primary/nursery student who is not yet able to engage fully in intellectual thought. Higher-order thinking in all its many forms is however an attainable goal in all classrooms at all class levels. Nursery and lower primary students can be problem solvers; you can still lead them to think about creative solutions to problems and to draw a diagram to help think about a puzzle.

The difference between high level and low level thinking can be well explained through Bloom's taxonomy



Level	Category	Description
1	Remembering/ Knowledge	The individual is able to remember ideas, facts, and theories. No change in behavior occurs at this level as it simply indicates the ability of the individual to remember information he/she was presented in the training. Example The individual can recite back the specific model learned on how to manage conflict. Activity examples: define, list, repeat, recall, duplicate, recognize.
2	Understanding/ Comprehension	The individual can comprehend the meaning of the material presented and predict consequences or effects from it. No change in behavior occurs at this level as the individual is able to describe their understanding of what is presented and discuss how the new material learned may or may not work in their own environment. The individual is able to explain the specific model learned on how to manage conflict in his/her own words. Activity examples: describe, discuss, explain, identify, review, and translate.
3	Applying	The individual can use the material he/she learned in new situations, applying concepts, principles, methods, and theories effectively. At this level, the individual demonstrates his/her ability to apply the new material they learned in the form of a measurable activity. This is the start in a change in behavior. For example, conducting an effective negotiation session or conflict management via role plays. The individual is able to apply the conflict model as learned in a role play situation. Activity examples: apply, demonstrate, interpret, practice, solve, use, illustrate.
4	Analyzing	The individual can break down the material learned into smaller elements or components so that its organizational structure is understood. At this level, the individual demonstrates his/her ability to analyze a situation using the knowledge learned by applying it to a case study. The individual will use his/her newly learned skills to understand the situation of the case study, determine cause and effect, and develop a solution to the problem. The individual demonstrates his/her knowledge by taking a systematic approach to analyzing the situation and developing a solution based on the analysis. Activity examples: analyze, compare/contrast, distinguish experiment, examine, and differentiate.
5	Evaluating	The individual is accomplished at judging the value of material learned for a given purpose and those judgments are based on defined criteria. At this level, the individual is able to take a multi-disciplinary assessment of a situation. He/she works from a defined set of criteria to make judgments about information presented in a case study, whether or not a solution is valid and the quality of a particular solution. At this level, the individual has mastered the new skill/knowledge. The individual is able to assess options and select the most effective conflict model (make changes to the conflict model) to utilize depending on a given conflict situation. He/she is able to assess a conflict situation to judge the best model to use for

		solving the conflict. Activity examples: appraise, assess, defend, judge, support, evaluate, value, and argue.
6	Creating	The individual builds a structure or pattern from diverse elements, puts parts together to form a whole, with emphasis on creating a new meaning or structure. Examples: Write a company operations or process manual. Design a machine to perform a specific task. Integrates training from several sources to solve a problem. Revises and process to improve the outcome. Activity examples: categorize, combine, compile, compose, create, devise, design, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize.

In Bloom's taxonomy, for example, skills involving analyzing, evaluating and creating are thought to be of a higher order, requiring different learning and teaching methods, applying is viewed as a transitional step from lower level to higher level of level of learning while remembering, understanding are thought to be of a lower order of learning.

Why Do We Want to Teach Higher-Order Thinking?

For decades, schools prepared children to be good citizens and good employees and students were expected to sit, listen, and do exactly as they were told. In some respects, this model served well since students learned to follow directions in ways that would be valuable to their future employers.

As economic and technological changes shape the occupational outlook of today's students, schools have begun to embrace the need to instill "higher-order thinking" to prepare the 21st century workforce. It is no longer enough for people simply to know basic facts and skills. To be successful, students must master decision-making, prioritizing, strategizing and collaborative problem solving. Such skills are also critical for responding to environmental change, which is occurring rapidly in our communities.

One of the main 21st century components that teachers want their students to use are higher-order thinking skills, is when students use complex ways to think about what they are learning. It is very important to focus on Communication, Collaboration, Critical thinking and Creativity (21 Century skills or 4Cs).

Communication allows sharing thoughts, questions, ideas and solutions among students and teachers. Collaboration encourages working together to reach a goal while putting different talents and expertise to work. Critical thinking helps students to look at problems in a new way while linking them to different subjects and disciplines while Creativity helps students to try new approaches to get things done through innovation and invention.

Teachers using high order thinking enable their students to understand concepts rather than just memorizing facts. The students are able to understand the facts and connect them to other concepts.

Information learned and processed through higher-order thinking processes is remembered longer and more clearly than information that is processed through lower order thinking. Consider for example, the difference between memorizing a formula and explaining how a formula is derived or, the difference between memorizing the definition of a new word and internalizing strategies for understanding the probable definition of the word from its context. Moreover, the student with the deeper conceptual knowledge will be better able to access that information for use in new contexts. This may be the most important benefit of high-order thinking.

Knowledge obtained through higher-order thinking processes is more easily transferable, so that students with a deep conceptual understanding of an idea will be much more likely to be able to apply that knowledge to solve new problems.

Strategies to enhance higher order thinking skills in students

Encourage questioning

A classroom where students feel free to ask questions without any negative reactions from their peers or their teachers is a classroom where students feel free to be creative. Encourage students to ask questions, and if for some reason you can't get to their question during class time, and then show them how they can answer it themselves, or have them save the question until the following day. It's better to pose questions that enhance critical thinking as opposed to closed questions. For example asking students "How would you hand waste that includes plastic bags, banana peelings and paper?" or "Why is it important to sort waste in your homes?" is better than "Do you sort waste in your homes?"

Connect concepts to everyday situations

Lead students through the process of how to connect one concept to another. By doing this you are teaching them to connect what they already know with what they are learning. This level of thinking will help students learn to make connections whenever it is possible, which will help them gain even more understanding.

Teach Problem-Solving Strategies

Teach students to use a step-by-step method for solving problems. This way of higher order thinking will help them solve problems faster and easier. Encourage students to use alternative methods to solve problems as well as offer them different problem-solving methods.

Encourage Creative Thinking

Creative thinking is when students invent, imagine, and design what they are thinking. Using your creative senses help students process and understand information better. Research shows that when students utilize creative higher order thinking skills, it indeed increases their understanding. Encourage students to think “Outside of the box”.

Teach Students to Elaborate Their Answers

Higher-order thinking requires students to really understand a concept not repeat it or memorize it. Encourage students to elaborate their answers and talk about what they are learning. This can be achieved by asking the right questions that make students explain their answers in more detail, or to answer their child’s question with a more detailed response.

You know that your students are engaged in higher-order thinking when they:

- Separate relevant from irrelevant information in a word problem
- Seek reasons and causes
- Justify solutions
- See more than one side of a problem
- Weigh sources of information based on their credibility
- Reveal assumptions in reasoning
- Identify bias or logical inconsistencies

ACTIVITY

1. Discuss as a group the steps in coming up with effective learning objectives. For example should be specific, measurable and achievable. Have the teachers share examples of learning objectives they use in routine teaching and as a group, critique and improve them and relate them to the different levels of blooms taxonomy.
   Example.

Level	Key Verbs (keywords)	Example Learning Objective
Creating	Design, formulate, build, invent, create, compose, generate, derive, modify, and develop.	*By the end of this lesson, the student will be able to* determine whether using conservation of energy or conservation of momentum would be more appropriate for solving a dynamics problem.
Evaluating	Choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select and evaluate.	*By the end of this lesson, the student will be able to* design an original homework problem dealing with the principle of conservation of energy."
Analyzing	Classify, break down, categorize, analyze, diagram, illustrate, criticize, simplify and associate.	*By the end of this lesson, the student will be able to* differentiate between potential and kinetic energy.
Applying	Calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, perform, present.	*By the end of this lesson, the student will be able to* calculate the kinetic energy of a projectile.

Understanding	Describe, explain, paraphrase, restate, give original examples of, summarize, contrast, interpret, and discuss.	*By the end of this lesson, the student will be able to* describe Newton's three laws of motion to in her/his own words
Remembering	List, recite, outline, define, name, match, quote, recall, identify, label, recognize.	*By the end of this lesson, the student will be able to* recite Newton's three laws of motion.

2. Divide the participants in groups of 6 and allocate each group a topic.
3. In 40 minutes, allow each group come up with 3 learning objectives with one at least focused on waste management and relate each to blooms taxonomy level. Groups should aim at higher levels of Bloom's taxonomy.
4. Each group then comes up questions that will guide them achieve each set objective.
5. Have the groups present and after each presentation, spend 3 to 4 minutes to critique the presentation.

REFERENCES

- Joyce Lockard, How to make fuel briquettes without a press. Beaverton Rotary Club, OR, USA.
- Geneletti, D. Combining stakeholder analysis and spatial multicriteria evaluation to select and rank inert landfill sites. *Waste Management.* 2010, *30*, 328–337.
- Mwampamba, T.H.; Owen, M.; Pigaht, M. Opportunities, challenges and way forward for the charcoal briquette industry in Sub-Saharan Africa. *Energy Sustain. Dev.* 2013, *17*, 158–170.
- Okello, C.; Pindozzi, S.; Faugno, S.; Boccia, L. Bioenergy potential of agricultural and forest residues in Uganda. *Biomass Bioenergy* 2013, *56*, 515–525.
- McGann, K, IBEC Education and Skills Survey, 2010.
- Barak, M, Shakman L(2008June) Fostering high order thinking in science class: teachers reflections.
- Haller, E J Monk , D.H and Tein L.T(1993) Small schools and high order thinking skills.