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Using ICT Mediated Constructivist Strategies to Integrate SDGs with Mathematics

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Abstract

A case study was undertaken to explore the scope and feasibility of integrating two sustainable development goals (SDGs) like sustainable consumption and economic inequality with mathematics using reflective practice. I used the real examples happening in our surroundings to replace the artificial situations provided in our maths text books to deliver. I explored environmental issues surrounding us and tried to quantify such situations to sensitise the students. Contextual materials were delivered using projector and audio system in mathematics laboratory. To ensure interaction the students were encouraged to form groups of three with whom they were comfortable to discuss. Students were encouraged to collect similar problems and discuss. Each group came up with several examples to quantify the social or ecological problems and other students participated in meaning making. Students were found to help each other in carrying out calculations involved. Many students were seen to convince their classmates and elders at home about the gravity of the imminent problems and effect of simple initiative in quantitative terms. It helped students express their concern and understand their role in reducing the effect of surrounding problems through their seemingly effortless initiatives. It helped me improve the bonding between me and my students through interesting eye opening topics to discuss on and off the regular class timings.

Keywords – Contextual Material, Environmental Issues, Quantifying Social Ecological Problem, Sustainable Development Goals

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Introduction

Building on the principle of "leaving no one behind" by 2030, 195 nations promised in 2015 to work on 17 sustainable development goals (SDGs). Here an attempt is made to integrate some of the SDGs with mathematics in a regular classroom interaction. If we can have environmental science then why cannot we have environmental mathematics? Maths plays a central role in school curriculum. Can it be used to sensitise our students about the imminent challenge of sustainable development? This was the basic question that motivated me to take up the task of sensitizing the students towards sustainable development through lessons in mathematics. I explored the areas in mathematics where integration of concepts in mathematics and sustainable development can take place. To my surprise I ended with many such places where there is fair chance of integration without losing original flavour of each discipline. I tried to develop culturally sensitive pedagogy taking instances from sustainable development. We took up issues like ratio of number trees to persons, proportion of different constituents in the slurry of biogas. IMR, MMR, food crisis, benefit of using public transport system on ecology, CO_2 emission from vehicles, effect of switching off ignition at traffic on reducing air pollution and saving money, need for safe driving habit and obeying traffic rules to reduce the number of road accidents, cost benefits analysis of waste management while mastering ratio proportion, percentage, compound interest etc. concepts in secondary classroom setting. Students were getting convinced about the usefulness of trees, snakes, butterflies, waste management etc. ; how simple action on our part can help them save a lot of money and precious resource for future use.

Literature Review

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 Goals build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities. The goals are

interconnected – often the key to success on one will involve tackling issues more commonly associated with another. The SDGs are unique in that they cover issues that affect us all. They reaffirm our international commitment to end poverty, permanently, everywhere. They are ambitious in making sure no one is left behind. More importantly, they involve us all to build a more sustainable, safer, more prosperous planet for all humanity.

Reflective practice – Your knowledge of content and method will change with the interaction of your formal university training and actual classroom experience. This change will result in what is called reflective practice, fuelled by your tacit, or personal knowledge gained from your day-to- day experience(Canning, 1991;Gill, 2000; Polanyi, 1958; York-Barr, Sommers, Ghere,& Montie,2006).

Objective

1. To find a variety of ways to integrate the concepts of sustainable consumption and economic inequality through regular mathematics classroom interactions.
2. How does the integration of SDG facilitate mathematics learning and help students imbibe the SD concepts?

Methodology of the Study

In the course of time the researcher tried to find the quantitative facts associated with the issues surrounding sustainable development and integrate such concepts with the classroom transaction of mathematics. This task was taken as case study for a period of four months where students of class 8 were exposed to treatment in the form of SD integrated mathematics and observed for their engagement at problem solving, improving their reading skills, calculation skills, active participation in the form of group discussion, taking the concepts to their homes, initiating problem making using authentic situation from their daily life etc. Initially the whole exercise was aimed at enriching children's experience with innovative techniques of presenting mathematical situations. Students were sensitized about the high price tag of readymade snacks of popular brands through quantitative calculation. Similarly the concept of ratio and proportion was introduced through IMR, MMR, available trees per person, proportion of NPK in the slurry of biogas, coal required to produce 1kWh of electricity, energy associated with using each piece of disposable etc. For example a question from Comparing Quantities Exercise 8.1 chapter 8 of NCERT class 8 textbook reads as

"If 60% people in a city like cricket, 30% like football and the remaining like other games, then what per cent of the people like other games? If the total number of people are 50 lakh, find the exact number who like each type of game."

The imaginary situation described in the problem was replaced with authentic contextual situation connected to the concept of sustainable development goal. The replaced problem reads as

To sensitise students about how through misleading and tempting advertisements the multinational companies befool us for earning huge profit by mentioning 100%, 80%, 50%, 40% etc. free. These topics were appropriately integrated in regular class room transaction using ICT specifically projector and audio system.

Simultaneously the mathematical skills of practising teachers of different subjects, some passed out students of the same school (B.E. 2nd year at the time of taking their interview) and pre-service teachers (both Mathematics and Biology stream) were tested using few questions from SD integrated mathematics of class elementary level to know about their reaction towards this pedagogy.

Results

The researcher scaffolded pre-service teachers about how to practise constructivism in spirit while taking elementary mathematics class in Demonstration Multipurpose School, Bhopal. The activity seems to enlarge the general awareness of all involved. At times I felt more conscious about my surrounding through these heart shaking numerals. We all in class felt more connected to each other as these numbers were eye opening for us. They could compare the sizes of different countries using the concept of ratio. The areas of different countries from the atlas were approximated for comparing. They could learn the concept of approximation and its need. Now vegetarians could gather another reason to argue about how they are causing lesser harm to nature by not consuming non vegetarian food products. Students could compare their food habits to find the quantity of energy and water involved in the making of their favourite food. Students could appreciate the importance of simple living on the conservation of natural resources through amazing numbers. They could better understand the harmful effects of junk food culture like acidic cold drinks, burgers, deep fried items, WHO recommended oil consumption for their family (500 ml per adult person per month), what is the forest coverage requirement of our city, state, country, emission levels etc.

Discussion

We took up issues like ratio of number trees to persons, proportion of different constituents in the slurry of biogas, cost benefits analysis of waste management while mastering ratio proportion, percentage, compound interest etc. concepts in secondary classroom setting.

Replacing traditional maths textbook problem with SD issue

- How does your chocolate eating habit affect our environment?
- Which food production causes minimum harm to our environment?
- How can I save water by changing my food habit?
- How can and to what measure I can reduce carbon foot print by keeping bare minimum number of fans and lights open in my class?

Introduction to SD concept through experimental facts

As much as 2 billion tonnes of food are wasted every year - equivalent to 50% of all food produced - according to a report published today by the Institution of Mechanical Engineers (IME). The IME estimate that 30-50% (1.2-2bn tonnes) of all food produced is "lost before reaching a human stomach". Consumer affairs correspondent Rebecca Smithers writes today:

The UK's Institution of Mechanical Engineers (IME) blames the "staggering" new figures in its analysis on unnecessarily strict sell-by dates, buy-one-get-one free and Western consumer demand for cosmetically perfect food, along with "poor engineering and agricultural practices", inadequate infrastructure and poor storage facilities.

The publication entitled 'Global food: waste not, want not' also aims to highlight the wastage of energy, land and water. Approximately 3.8tn cubic metres of water is used by humans annually with 70% being consumed by the global agriculture sector. The amount of water wasted globally in growing crops that never reach the consumer is estimated at 550bn cubic metres.

IME claim that water requirements to meet food demand in 2050 could reach between 10-13.5tn cubic metres per year - about triple the current amount used annually by humans.

Meat production requires a much higher amount of water than vegetables. IME state that to produce 1kg of meat requires between 5,000 and 20,000 litres of water whereas to produce 1kg of wheat requires between 500 and 4,000 litres of water.

The United Nations states that livestock farming is responsible for 18% of the carbon dioxide equivalents emitted worldwide, more emissions than the entire transportation sector.

Introducing facts through table for self introspection and inquiry

1 kg chocolate requires 17,196 litre of water. Similarly water consumption is given in Table 1 for some food products.

Table 1 Water consumption related to different foodstuff

1 kg Food product	Quanity of Water (litre)
Beef	15415
sheep meat	10412
Butter	5553
Rice	2497
Apple	822
Banana	790
Potato	287

Based on this the students were encouraged to form questions in their respective groups and solve. These activities led to engage students in meaning making and calculation. Some of the sample questions discussed are as follows:

1. It takes approximately 57 calories of energy to produce 1 calorie of lamb compared to 1 calorie of inputs to create 4 calories of corn. You want to compensate 600 calories of energy. Your friend depends on lamb and you on corn for energy. Who saves and by how much energy?
2. Your friend consumed a lunch 100 g chicken. You consumed 100 g corn. By your action how much energy you could save in comparison to your friend.
3. Name one of your habit that you can replace to reduce carbon foot print.

The table 1 shows typical values for the volume of water required to produce common foodstuffs. Chocolate tops the list with 17,196 litres of water need to produce 1kg of the product. Beef, sheep and pork meat all require high volumes of water for production also. Tea, beer and wine use the least according to the list. Compared to the production of meat, vegetable foodstuffs require considerably less water - 1kg of potatoes for example uses 287 litres of water.

Integrating assessment with SD concepts

Concept: It takes around 3.4 mega joules of energy to make a typical one-litre plastic bottle.

Q. How much energy is needed to produce 1000 bottles?

Concept: Each unit of methane has about 25 times the global warming potential as carbon dioxide.

Concept: Women comprise on average 43 per cent of the agricultural labor force in developing countries, and over 50 per cent in parts of Asia and Africa, yet they only own 20% of the land.

Q. How much PET is needed to make one 1litre plastic bottle? How many water bottles are used in our country daily? What is the total weight of PET needed to produce these bottles?

Think globally and act locally.

Critical thinking

Why is it better to drink water from an earthen pot than water cooler?

Very interesting and creative points came out during these interventions.

Conclusion

Integrating the SD concepts with mathematics comes with the challenge that a lot of preparation is needed on the part of teacher prior to taking class. Basic facilities for ICT mediation like projector, access to internet to get facts, teacher's knowledge and sensitivity towards ecology and current state affairs related to this makes the integration smooth and interesting. Students were scaffolded to be involved in meaning making and self composing questions on different aspects of the problem to sensitise others. There was continuous sense of discovering facts which kept the class vibrant and ensured after class interaction with teachers, school bus mates and members of family. It is suggested to replace the present contents of mathematics text book with real and authentic situation from surrounding problems. More research needs to be done to explore further scope for integration.

References

1. Berthold, K., & Renkl, A. (2009). Instructional aids to support a conceptual understanding of multiple representations. Journal of Educational Psychology, 101(1), 70-87.
2. Bousted. 2005. Eco-profiles of the European Plastics Industry: Polyethylene Terephthalate (PET), (Bottle grade).
3. Chi, M.T.H., Bassok, M., Lewis, M. Reimann, P., & Glaser, R.(1989). Self explnanations - How students study and use examples in learning to solve problems. Cognitive Science, 13(2), 145-182.
4. Davis, E.A., & Linn, M.C.(2000). Scaffolding students' knowledge integration: Prompt for reflection in KIE. International Journal of Science education, 22(8), 819-837.
5. http://healthyhumanlife.com/glass-water-bottles/plastic-water-bottle-facts/

6. Jackson, B.D.(2014). Algebra homework: A sandwich. National Council of Teachers of Mathematics, Mathematics Teacher, 107(7), 528-533.
7. http://lca.plasticseurope.org/petb5.htm
8. National Curriculum Framework-2005, NCERT.
9. New Trends in Mathematics Teaching, Vol.II, The International Commission of Mathematical Instruction(ICMI),1970.
10. Ryoo, K., & Linn,M.C.(2014). Designing guidance for interpreting dynamic visualizations: Generating vs. reading explanations. Journal of Research in Science Teaching,51(2),147-174.

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