Different classroom activities derived from topic minicomposting – a step toward pro-environmental behaviour of students

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Abstract. *Students of different grade classes of primary and other school system should be aware of environmental issues. Beside knowledge students should possess competence for taking action in relation to the environment. In light of this we designed activities that provide students the opportunity to appropriate and internalise the knowledge concerning certain environmental issues. We present different activates for students from 6th to 9th grade classes of nine year primary school regarding wastes; e.g wastes, composting, chemical analysis of waste water samples, and (geno)toxicity tests of waste-water*.

Keywords. Compost, Chemical analyses of waste-water, Environmental education, (Geno)toxicity tests, School activities.

1. Introduction

Topics of Slovenian science curriculum concerning environmental issues are scarce and mainly discussed in the first and the second triad of a nine year primary school. Increasing government and public concern about degradation of the environment and awareness of environmental issues on the other hand lead us to design school activities through which students gain knowledge about a more appropriate waste dumping and become aware that only technology cannot solve environmental problems. As early as 1973 Maloney and Ward [1] believed that ecological crisis is a consequence of a crisis of a maladaptive behaviour. Therefore it is important that students learn to take care for the environment. Fien et al. [2] stated that every teacher is responsible for infusing environmental education into his / her teaching in order to help students to live and work towards a more sustainable environment for all. Knowledge that students gain in school is one among many important preconditions for the development of competence leading to act and behave pro-environmental [3]. However, knowledge *per se* does not lead to environmental action or the development of pro-environmental behaviour [4].

Jensen [3] enlightens such thinking with two factors. He believes that traditional knowledge about the environment as it is thought in the school is not action oriented, and environmental education in his opinion oriented on passing knowledge to pupils. In such way pupils don't get the opportunity to actively appropriate and internalise the knowledge they gain through lessons. In light of this believe we prepared school activities through which students would develop competences by leading action and behaviour adjustments in relation to the environment. We prepared activities that included:

(1) students investigations about how much wastes produces one student per day,
(2) investigations about how student treat wastes,
(3) searching for wastes which could be composted,
(4) chemical analysis of waste-water samples that were a by-product of decomposition of peels and batteries, and
(5) (geno)toxicity test of waste-water samples.

In activates carried out in school years (2008/09 and 2009/10) participated students from 6th to 9th grade classes, altogether 63 students. Activities were part of a science (6th grade class), a biology (9th grade class), and a chemistry (8th and 9th grade classes) lessons.

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2. Description of activities

2.1. Wastes

According to data of Slovenian statistical office (Statistični urad Republike Slovenije), Slovenians on average produce 1.24 kilograms of communal wastes per day. Alarming is that 74 % of all wastes are dumped on city dump and only 11% are separated by recyclable items by the users. According to these data we ask students of 6th grade class (N = 47) which (paper, plastic, pells ...) and how many wastes they produce when making one daily ration. In addition to these two questions we asked students how they treat wastes.

Each 6th grade class student prepared and presented a poster. We found out that students produced wastes mainly of a plastic, paper or organic origin (Fig. 1). We calculated that one student on average produces 0.6 kilograms of wastes per day (Fig. 2), which is lower than Slovenian statistical office reported. The result was not surprising. Students explained it with that we daily produce wastes that are not only by products of daily rations. We also found that many 6th grade class students separate wastes by the source. However, those who stated otherwise support the separation of wastes by the source. But from their statements it was evident that for such actions these students don't get support by their parents.

Figure 1. Posters presenting wastes which were obtained from one daily ration

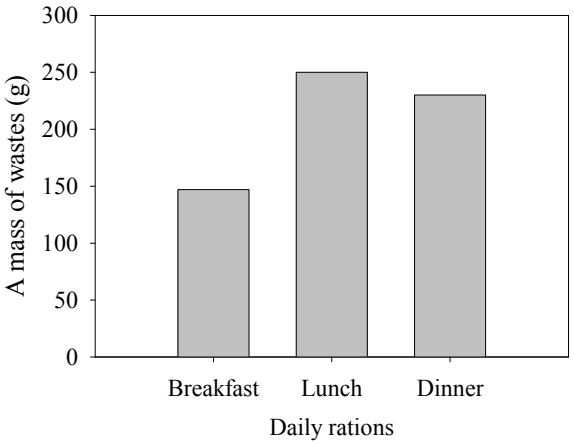

Figure 2. A mass of wastes produced by preparing a daily ration

After poster presentations, 6th grade class students wrote reflections about how to reduce the daily mass of wastes. Students provide answers that we should:

- separate wastes by the source,
- buy products with less package,
- develop recyclable package,
- compost organic wastes,
- make new products from packages,
- use wastes as isolation material for houses,
- extra pay for packages ... etc.

From their answers we can conclude that students are prepared to act in a way to minimize the mass of wastes.

We found that many students act pro-environmental. They separate wastes by the source, compost organic wastes, and use recyclable bags. We also found that family support is an important factor that influences on pro-environmental behaviour of students.

2.2. Waste recycling

Students believe that one step toward minimizing the mass of wastes is the decomposition of organic wastes. According to theirs suggestion we prepared two composts (Fig. 3). In one compost we set peels and in another batteries to decompose. Throughout this activity 6th grade class students observed decomposition of organic wastes. In addition they observed animals in compost and constructed food chains.

Compost where batteries were set to decompose was meant to show students:

(1) that batteries don't decompose like peels and
(2) dumping them on inappropriate way could have potentially negative impact on the environment.

To examine these, we carried out some tests; chemical analysis of waste water samples, *Daphnia magna* (toxicity test) and *Allium cepa* (genotoxicity) test. Students of 8th and 9th grade classes carried out these tests. Results were presented to students of 6th grade class. It should be noted that students of 7th, 8th and 9th grade classes were aware of what the 6th grade class students were working on. In addition to this, students from 7th and 8th grade classes were in previous school year (2008/09) working on decomposition of different materials (e.g. metal, litter, peels, and batteries).

Figure 3. Students preparing compost

2.3. Analysis of waste-water samples

During decomposition one of the by-products is waste-water. In order to asses if waste-water could have potential negative impact on the environment students carried out chemical analysis of waste-water samples (Fig. 4). Samples of waste water were taken from composts which were prepared in school year 2008 / 09. As negative control water from public supply was used.

Figure 4. Students carried out chemical analysis of waste-water

Students of 8th and 9th grade classes analysed samples of waste-water of peels and batteries decomposition. They measured parameters as NH_4^+, NO_2^-, NO_3^- and pH. Students found that measured parameters were in accordance with Slovenian legislation for all samples except for $NO3^-$ for battery waste-water sample. Permitted limit value (PLV) published in the Official Gazette RS (2000) for NO_3^- for this sample was exceeded 8 times.

The main scope of this activity was to present students that if permitted limit value of certain parameter is not in accordance with Slovenian legislation that parameter could have potentially negative impact on the environment.

In addition to chemical analysis students carried out toxicity test with *Daphnia magna* (Fig. 5) and genotoxicity test with *Allium cepa*. As negative control for (geno)toxicity tests water from public water supply was used.

Figure 5. Student counting *Daphnia magna*

For evaluation of waste-water as pollutant we decided to combine chemical analyses with bioassays. Namely, chemical analyses are limited in their ability to characterize pollutants and their potential effects on living organisms [5]. Bioassays, on the other hand, consider bioavailability and bioaccumulation of chemicals as well as interaction among the pollutants and provide information about the toxic and

genotoxic potential of pollutant affecting living organisms. Integration of physico-chemical and biological approaches in ecotoxicological studies is therefore recommended for evaluation of environmental risk [6]. We adopted protocol for *Allium cepa* test according to [7] and for *Daphnia magna* according to *Daphnia magna* acute toxicity test by Department of Environmental Chemistry, ICT Prague.

Results for *Daphnia magna* test indicated that only waste water sample from battery compost was toxic. Genotoxicity tests are still in progress; therefore no results are presented in this paper.

Through activities students could learn that dumping batteries in the nature could have potentially negative effect on the environment and therefore following the regulations of dumping the hazardous wastes is obligatory. In addition, students got experience how to work in a laboratory, which safety recommendations should be aware off and that answers about effects of pollutants on environment require a usage of different tests.

3. Conclusions

Through different activities presented in this paper students gained knowledge about proper and useful waste dumping, which will hopefully be implemented outside the classroom in students` everyday lives. Students learned that careless dumping of hazardous waste has negative impact on the environment.

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