Abstract
The paper corresponds to an intervention of a Center for Research in Brazil (NUPEDEA) in a community of small farmers at risk situation by the use of pesticides. The study was conducted by undergraduate Chemistry students and professors from the Federal Institute of Education, Science and Technology of Goias, Anapolis Campus, in the city of Joaõpolis/Goias/Brazil, in the rural area where the agricultures live and in the urban area where their children go to school. The problems which have led to the intervention in the community were: verification of high rate of cancer; children/juveniles working in the plantations without personal protective equipment (PPE); little knowledge about the products in use. The study takes place at the little town school and at the food production sites. Our aim is to provide knowledge about the risks to health, the importance of using PPE and about alternative products which can be less harmful. The food, soil, and people’s clothing chemical analysis showed high rate of contamination. Thereby, we have developed materials with information and we have regularly visited the school and the farms. The field research demonstrates some changes in behavior that are considered favorable factors against the risk situation in which those people live.

Keywords: Critical Environmental Education; pesticides; social vulnerability.
Introduction

The current study was held under the Critical Environmental Education perspective as a possibility of forming knowledge to fight the risks due to pesticides use in a small community of farmers in Joanapolis, Goias, Brazil. The focus of the proposal is to raise the main problems in this framework and start the process of empowerment of individuals through information on the use and problems arising from the indiscriminate application of pesticides in agriculture.

This research aims to contribute to the process of empowerment of individuals through education and knowledge by critical environmental education. This is a quantitative and qualitative research. Data were collected through observation notes in field diary, visual record of photographs, interviews with members of the community, access to official documents and sources of information on the Joanapolis community.

Center for Research in Brazil (NUPEDEA)

This paper presents the first stages of an action-research held by the Center for Studies and Research on Teacher Education and Environmental Education (NUPEDEA). NUPEDEA is a newly established center in the Federal Institute of Education, Science and Technology of Goias (IFG), Anapolis Campus. In 2014 it was registered and certified by the Brazilian National Council of Scientific and Technological Development. It is composed by professors from different fields and undergraduate students in the Bachelor in Chemistry and Education course.

Currently, NUPEDEA is located at the Anapolis Campus, one of 14 campi of IFG. Studies and researches have been held in two different but converging fields: teacher education, especially natural sciences teaching, and environmental education regarding sustainability and empowerment in situations of social-economical vulnerability. About 10 professors from various fields and 30 undergraduate students have been developing 12 different researches.

Figure 1: NUPEDEA location. Figure 2: NUPEDEA researchers meeting.
NUPEDEA’s main goal is to articulate research, teaching and outreach to develop education and social promotion. In this regard, all activities held by the group are greatly focused on social intervention.

**Critical Environmental Education and Empowerment**

The theoretical basis of critical environmental education guides the perspective of this study. We assume that only information about natural space components is insufficient and that, with so many adverse issues nowadays, critical formation is necessary for people to confront situations that jeopardize their very survival (FOLADORI, 2001; LEFF, 2010).

We believe that critical environmental education may be part of a process capable of providing subsidies to the challenges of contemporary life. This perspective considers the human being within the space of social and environmental dimensions, seeing life in its complexity and understanding environmental issues not restricted only to the natural dimensions of space (OLIVEIRA, 2016).

The main purpose of critical environmental education lies in the formation of a subject able to identify, challenge, propose solutions and act in the face of adverse social situations. And the development of these capabilities is through proper involvement of people in their social, political and economic contexts. In this sense, the critical perspective of environmental education would foster the formation of contextualized knowledge, a more complex and instrumentalized reading of the world for social intervention (GUIMARÃES, 2004; 2007).

However, it is important to note that knowledge alone does not guarantee changes in adverse social frameworks. Changes happen through the intervention of the subjects, in which collective action is critical because it potentiates greater involvement of individuals and stimulates the formation of leaders that streamline the organized social groups (OLIVEIRA, 2016). Thus, people may have increased capacity to identify, analyze, claim their rights and the provision of services, among other citizenship attitudes (SAITO, 2000; GUIMARÃES, 2004; LOUREIRO, 2012).

In this study, empowerment is understood as a dynamic process that aims to increase the autonomy of people in their social contexts. It generally refers to groups or individuals subjected to conditions of oppression and social vulnerability. In this sense, empowerment aims to develop critical views and sustainable positions to face adverse issues (BAQUERO, 2012; FRIEDMANN, 1992; GOHN, 2004; HOROCHOVSKI; MEIRELLES, 2007; NARAYAN, 2002; ROMANO, 2002; WENDAUSEN; KLEBA, 2009). It corresponds to the process in which people build conditions that allow them to have influence, capacity for action and decision to arbitrate on issues that concern themselves (FRIEDMANN, 1992; NARAYAN, 2002).

**Research context**

As already mentioned, this paper presents the early stages of an action-research held by NUPEDEA together with a small community of farmers at risk by the use of pesticides in the very small town of Joaína/Goias/Brazil. The research has been
developed in site, i.e., in the plantations and farms where the people work and live and in the small town school where the farmers’ children study.

NUPEDEA is located at the Anapolis Campus of IFG, a region where the city of Joanapolis and many other small towns and rural areas are located. The map below illustrates the area.

![Figure 3: Place of research: Anapolis area and Joanapolis town.](image)

When we turn to the environmental dilemmas surrounding the city and region of Joanapolis, we face situations of risk to the lives of people, which have led us to intervention in the community. We found high cancer rate, children and adolescents working in agriculture, inadequate and/or indiscriminate handling of pesticides, use of banned poisons, lack of protective equipment and little knowledge regarding the products used.

As NUPEDEA tries to articulate teacher education engaged in social environmental issues, we have tried to recognize and understand the social context of these farmers and intervene in situations of risk, with the development of actions that are planned and executed by the university professors, the undergraduate students of Bachelor in Chemistry and Education course and the community members.

The critical perspective of environmental education was assumed in the empowerment of individuals. However, it is important to note that this research effort is based on an empirical context, characterized by the interaction between small farmers and college students and professors, to provide a framework of lower risk to life resulting from the use of pesticides.

The constitution of this knowledge among farmers, contextualized in risk situations experienced by the use of pesticides, corresponds to the main objective of the study. Based on reports on the practices of farmers by one of the undergraduate students,
who has lived in the community since childhood, our hypothesis was that this knowledge would be low among these farmers.

Even though the study is still under progress, the research stage already allows some inferences, especially with regard to the socio-environmental context of farmers, as we are going to show next.

Results and analysis

To reach the objectives of this research, two locations were chosen for the development of the activities: the small rural properties where the farmers work and live and where the plantations are located and; the small town school, where the farmers’ children study.

The research was divided into 4 execution steps:

1. Identification of social-economic aspects of the community;
2. Identification of risk situations;
3. Knowledge formation regarding pesticides;
4. Implementation of changes in the community attitudes.

Regarding the first step, data were collect by means of observation notes in field diary, visual record of photographs, interviews and official documents. Although we already knew it is a very poor community in a situation of social vulnerability, data shows that 100% of families have over 5 people and, in this scenario, 75% of children over 8 years old work in agriculture with pesticides. Agriculture is the only income source for 96% of the families, but only 5% of them own the land where they live and work, and 93% of the people have studied under elementary school level. 85% of the people have lived in this rural area for over 10 years, and life has been very difficult, with little or no government interventions and/or access to public services. The chart below summarizes the social-economic aspects of the community.

<table>
<thead>
<tr>
<th>Social-economic aspects of the community</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Families over 5 people</td>
<td>100%</td>
</tr>
<tr>
<td>Have lived in the rural area for over 10 years</td>
<td>85%</td>
</tr>
<tr>
<td>Agriculture as the only income</td>
<td>96%</td>
</tr>
<tr>
<td>Own the land</td>
<td>5%</td>
</tr>
<tr>
<td>Under elementary school level</td>
<td>93%</td>
</tr>
<tr>
<td>Children over 8 work in agriculture with pesticides</td>
<td>75%</td>
</tr>
</tbody>
</table>

Figure 4: Social-economic aspects of the community.

Regarding the second step, the following risk situations were found: use of prohibited poisons and pesticides harmful to human health; careless use of pesticides; contamination of local soil and water resources; low/non use of individual protection equipment; high levels of chemicals present in food items. The following images illustrate some the findings.
As we can see in the images above, the farmers have been using DDT, pesticide derived from Aldrine, Endrine, BHC, amongst others illegal pesticides which they buy from dealers due to the low price compared to legal pesticides. On average, farmers use from 8 to 12 different kinds of pesticides in 80% of their plantations.
As the images above clearly show us, 0% of the farmers uses suitable individual protection equipment. That includes the children who work in the plantations. To deepen the analysis and to provide a basis for knowledge formation, chemical analysis was held regarding the substances handled and their quantities. As a parameter, the
Brazilian laws and regulations on the use of pesticides and chemicals in food production were taken into consideration. The following chart presents the analysis results.

<table>
<thead>
<tr>
<th>Analyzed component</th>
<th>Predominant chemicals</th>
<th>Recommended level – level of contamination (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial layer of soil in fruit and vegetables plants (15 cm)</td>
<td>1- Organophosphorates; 2- Organochlorines; 3- Carbamates; 3- Metals (Pb, Cd e Ar);</td>
<td>1,57 µg/m³ - 9,47 µg/m³; 2,09 µg/m³ - 11,02 µg/m³; 12,01 µg/m³ - 137 µg/m³; 0,2-20 mg/Kg - 1,3-124 mg/Kg</td>
</tr>
<tr>
<td>Superficial running water nearby plantations (100 m)</td>
<td>4- Carbamates; 5- Organochlorines; 6- Glyphosate;</td>
<td>20 µg/L – 257 µg/L; 0,03 µg/L – 48,9 µg/L; 500 µg/L – 3789 µg/L</td>
</tr>
<tr>
<td>Food (leaves and fruit)</td>
<td>7- Organochlorines; 8- Organophosphorates; 9- Metals (Pb, Cd e Ar);</td>
<td>0,01µg/Kg – 1,2 µg/Kg; 0,05µg/Kg – 2,1 µg/Kg; 0,2-20 mg/Kg - 30-300 mg/Kg</td>
</tr>
<tr>
<td>Food (roots and tubers)</td>
<td>10- Organochlorines; 11- Organophosphorates; 12- Heavy metals;</td>
<td>0,01µg/Kg – 0,8 µg/Kg; 0,05µg/Kg – 1,01 µg/Kg; 0,2- 20 mg/Kg - 8-130 mg/Kg</td>
</tr>
</tbody>
</table>

*Recommended / permitted level according to Brazilian laws and regulations.

Figure 9: Chemical analysis.

As we may see, the levels of contamination greatly surpass what is permitted by law. Regarding the superficial layer of soil in the plantations, contamination reaches over 600% higher than permitted. Regarding water supplies, contamination reaches over 750% higher than permitted. Regarding direct food samples, leaves and fruit seem to be the most contaminated. Contamination in food samples reaches over 1500 times higher than permitted.

From these alarming findings, the next step of the research was put into implementation. Actions were promoted regarding knowledge formation about pesticides. In the school where the farmers’ children study, the undergraduate students of Chemistry and Education conducted rounds of conversation, readings, educational activities, workshops, lectures etc. These activities were planned and organized together with the university professors and the local teachers at the school. The images that follow illustrate the execution of this step of the research.
Figure 10: Knowledge formation at the town school.

After the activities of knowledge formation at the school, the farms were also visited by the researchers together with the farmers’ children. Rounds of conversation were also conducted by the undergraduate students.

Figure 11: Knowledge formation in the rural area.

As the fourth and last step of this action-research, we proceeded to the implementation of changes in the community attitudes. All the farmers were visited and rounds of conversation were held with all the farmers and their families. The farmers had the chance to share their experiences, doubts and insecurities and to build new knowledge and attitudes from that. The images that follow show this moment of the research.
The group of undergraduate students and professors also worked with the farmers in order to help them recognize and use alternative products and reduce the use of illegal pesticides. The images below show part of this work.

**Conclusion**

The research has allowed us to understand that the knowledge the farmers usually have regarding the use of pesticides come from their own experience and observation (by seeing others doing it) and from shared conversations and experiences with others who recommend the use of this or that product. This leads us to conclude that the farmers had little access to information regarding the toxicity or level of contamination which pesticides may cause.
From these initial evidences and based on the theoretical and methodological frameworks in which we based our work on, we can affirm that the construction of contextualized knowledge may contribute to people empowerment in risk situations they experience daily.

We emphasize that the perspective of environmental education we assume contributes to this process. In the current development stage of the study, we have built a gradual involvement with farmers and their families in their activities. We believe that the formation process of critical environmental education collaborates so that people can make their own choices, gain greater control over the circumstances, participate in decisions regarding their own lives, and develop a critical view and positions in the face of risk situations often ignored due to the little knowledge about its causes and consequences.

The empowerment process can occur in this community of small agricultural farmers through capacity building for these people to initially realize the facts that surround them, discuss and decide on situations that concern themselves. In this sense, their very participation/action in their social contexts, mediated by information and stimulating critical thinking, can lead them to empowerment.

We may conclude that ways might emerge to empower these individuals, since the results obtained in this part of the studies were satisfactory. We perceived good reception by the people who participated. They have shown interest in deepening their knowledge of the subject matter. We learned that they were surprised by some information that were addressed, but likewise excited by the possibility of information. We also highlight as positive the promotion of a sense of union among farmers, which until then did not exist, to approach the subject in a collective way.

We believe that the empowerment of these subjects for a better attitude against the risk of inappropriate use of pesticides corresponds to a process that will take place gradually over a systematized work. Regarding the development of this study, its main objectives were achieved. Thus, as the proposed empowerment of these subjects also results from NUPEDEA activities, the continuation of this process will take place by means of other forms of intervention in this community, which will be developed in 2016 and 2017.
References


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