

## Competence in environmental ethics in the risk management in agroecosystems

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### Abstract

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Environmental Ethics (EE) provides an ethical approach in the study of environmental risks in the agroecosystems. As a disciplinary field in the universities, environmental ethics ensures scientific quality in the students' preparation. In the present research: · we offer reflections on the ethical approach in the agricultural sciences; · we present the environmental ethics as a trend in the education and research for students and PhD students regarding the risks in the development of the agroecosystems; · we interpret the possibilities for applying an ethical approach in problem solving for the risks in the development of the agroecosystems.

In this article, we will address the opportunities for integrating environmental ethics and the ethical approach in solving problems concerning climate change, food resources guarantee, biodiversity, quality of agricultural products and others. The study shows that the development of competence in environmental ethics has a positive effect in the study of risks in the agrosystems.

Our study contains three main *contributions*: · it contributes to the enhancement of the environmental education on the possibilities for regulating the relationship between people and the environment with the benefits of EE; · it offers tools for solving environmental problems based on EE; · it considers opportunities for expanding the influence of EE for the formation of competence in EE as an integral part of the development of coordinated skills in the biology and agricultural sciences students.

*Keywords*: competence in Environmental Ethics; agroecology; sustainable development

### Introduction

The contradiction between the technological progress of mankind and the deepening of the ecological crisis raises the need for alternative mechanisms for harmonizing the relationship between humans and nature. This is difficult to achieve only by limiting technological development and overconsumption. A deeper and more conscious understanding of the relationship between people and their environment is needed.

Ecology, ecological education and ecological ethics arise and develop not only for the normal functioning of the rela-

tions in the society, but also for the regulation of the interaction between humans and the environment.

The ecological training of the future specialists in the universities is constantly enriching its content with new scientific perspectives and disciplinary fields. Such is the discipline of *Environmental Ethics (EE)*, which is included in the curricula of specialties with environmental orientation (Lin et al., 2020; Lopez, 2020).

The management of the environmental risks in the creation and development of the agroecosystems can be supported by the ethical approach. It provides new set of tools

for the environmentalists to tackle environmental problems and to maintain sustainable development in the ecosystems, and in particular, in the agroecosystems.

The *objective* of the present study is:

- to interpret the possibilities for application of an ethical approach based on the development of competence in environmental ethics of the environmental specialists in the process of their training.
- to identify the level of competence in environmental ethics in the students in the process of EE learning.

## Materials and Methods

This study covers the period between 2012-2020, in which the following were conducted: · theoretical analysis of the research in international journals; · conceptual modeling of an experimental study for the formation of EE competence in the educational process in the disciplines Environmental Ethics and Bioethics, respectively for the specialties Ecology of Biotechnological Research and Ecology and Environmental Protection at the Faculty of Biology of Plovdiv University “Paisii Hilendarski”.

The study included students (N = 98) in their 2nd and 3rd year in the academic process in the disciplines of *Environmental Ethics* and *Bioethics*.

We rely on three constructs in the curriculum in these disciplines, which outline the prospects for the development of EE competence in the students, namely: 1. The *objectives of the course* include as “expected results” for the students to be able to research and solve environmental problems; 2. The *content* of the course covers topics that address ethical cases on environmental issues encountered in ecosystems (agroecosystems); 3. In the *expected “end results”*, students should be able to perform a critical analysis of environmental issues in an ethical context and include ethical aspects in their decision making.

In order to determine the progress in the formation of EE competence, we use UF-EMI test (University of Florida Engagement, Maturity and Innovation) UF/EMI Critical Thinking Disposition Instrument is an instrumentation tool developed by Florida University researchers to measure critical thinking disposition because of the need for measuring critical thinking disposition in an effective way and having an instrumentation tool which includes fewer factors than existing ones (Miller et al., 2011). This test consists of 26 questions, presented by three constructs. Eleven questions rated Engagement, eight questions rated Cognitive maturity and seven questions rated Innovativeness of the respondents. Each question was measured on a 5-point Likert scale (1 = strongly disagree) to (5 = strongly agree). The overall rating

of the instrument ranges from a low of 26 to a high of 130 points. It is assumed that the higher the score, the stronger the critical thinking of the respondent (Miller et al., 2011).

## Results and Discussion

Risks in the agroecosystems are often associated with solving environmental problems of varying nature.

Environmental ethics is one of the starting points for redefining the possibilities for solving environmental problems and dealing with environmental risks. It is an important part of the environmental education in universities, which is responsible for the development of environmental competence in various areas, one of which is competence in environmental ethics.

### *The role of environmental ethics in the students’ academic preparation*

EE offers an ethical review of environmental issues based on moral solutions. Among those are reduction of biodiversity, non-environmentally friendly exploitation of natural resources such as soils, waters, plant resources, uncontrolled application in agricultural practice of genetically modified crops and many more.

EE provides innovative tools for making moral decisions on environmental issues (Minteer & Collins, 2008; Dickson, 2000), as well as for achieving the goals of a sustainable development (Petrova et al., 2020). EE reveals an in-depth philosophical interpretation of how one should live (Taylor, 2011; Stenmark, 2017; Light, 2002) and how to make effective decisions on environmental issues (Kassiola, 2003).

A number of researchers (Minteer & Collins, 2005; McCoy & Berry, 2008) have revealed the link between EE and solving environmental problems, as well as the need to promote the use of EE in the study of environmental risks. Their ethical interpretation can help predict the environmental consequences. Environmentalists look for reasons in various aspects of EE (Dickson, 2000; Norton, 2009) in solving ethical environmental problems. These ideas are also supported by research on sustainable development (Holmberg et al., 2008; Cebrián et al., 2020).

EE offers an ethical approach to dealing with environmental situations having a moral and ethical context.

The application of this mechanism in risk assessment in an agroecosystem is possible through critical analysis based on critical thinking. The interconnectedness of these components is presented in Figure 1 and Figure 2.

The role of critical thinking in solving ethical environmental problems has been interpreted in studies such as Dewey (1997), Ertaş & Şen (2014), Abrami et al. (2015), Ennis (2018).

Environmental ethics still needs a method to address these issues. The participation of the students in the search, observation, documentation, analysis and interpretation of conflict situations in the environment and the attempts to adhere to scientifically sound solutions are successful. The problem-solving model developed through our experiment proved to be productive, well-accepted and applicable to the education of pupils and students in the field of ecology and environmental ethics. It helps them develop interactive skills for solving environmental problems, and also teaches them constructive and tolerant interactions.

### Competence in environmental ethics

We found that EE training has a positive impact on the development of EE competence by considering environmental management with ethical regulatory mechanisms.

Based on the studied literature, we claim that EE training can be a key tool in the formation of skills for environmental problems tackling.

The development of *EE Competence* is an important part of the professional training of the specialist ecologists.

They must have dynamic skills, attitudes and competencies to improve the ecological performance of the ecosystems (agroecosystems) and their competitive advantage for sustainable ecological and economic development.

Figure 1 shows the content elements and the stages of formation of EE competence.

Today the solving of environmental problems needs the unity of ecological, social and economic systems. Therefore, tackling environmental problems is associated with value-oriented (Arvai & Gregory, 2003), structured approach-

es (Wilson & Arvai, 2006), decision-making approaches, as well as value-based decisions (Gregory, 2000) and creative decisions (Weston, 2006). To alleviate the complexity of environmental decisions, it is necessary to develop and study structured decision-making approaches (Wilson & Arvai, 2006).

### Statistical evaluation

Descriptive statistics and Student's t-test were used for statistical evaluation of the results ( $p < 0.05$ ). All statistical analyses were made with the SPSS ver. 19 statistical package (IBM Inc.).

The systematic data of the UF-EMI test before and after the course of training in Bioethics and Ecological ethics are presented in Table 2. Students have generally improved both their attitudes and cognitive skills to analyze different environmental case studies (Table 1 and Table 2), to present arguments in support of a particular opinion, to offer alternative solutions to a particular problem, and to compare their effectiveness, to predict the consequences of a particular event or decision by reflecting their own thinking.

For all respondents ( $N=98$ ), the mean total score of the UF-EMI pre-test was calculated as 90.44 while the mean total score of the UF-EMI post-test reached 96.41 (Table 1). Mean scores after the course of training in Bioethics ranged from a low of 64 to a high score of 112. The UF-EMI utilizes the CCTDI cutoff points developed by Facione (1998; 2011) to determine a strong, medium, and weak disposition to Critical Thinking. A reported score of 136.95 or higher on the UF-EMI is considered a strong disposition while a 135.30 to a 110.55 score is moderate, and a score of 108.90 or less constitutes

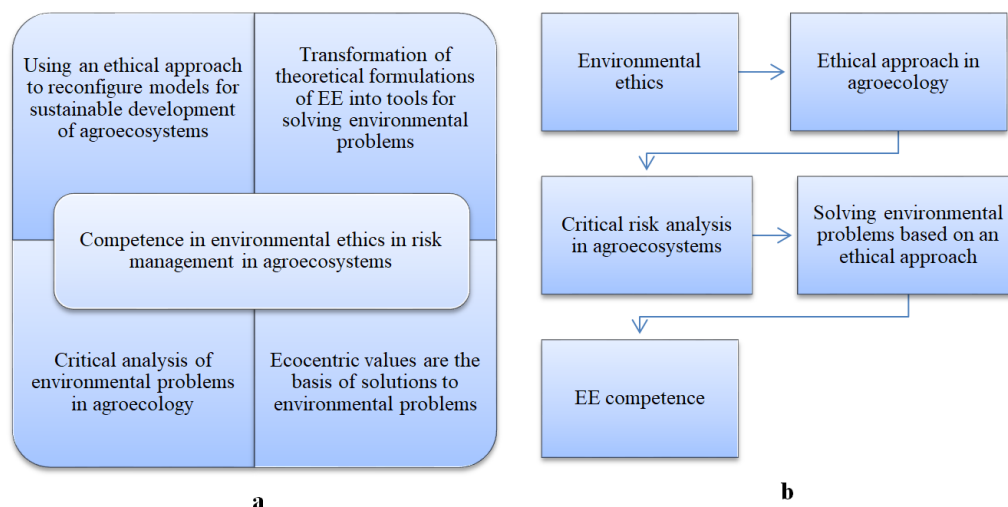
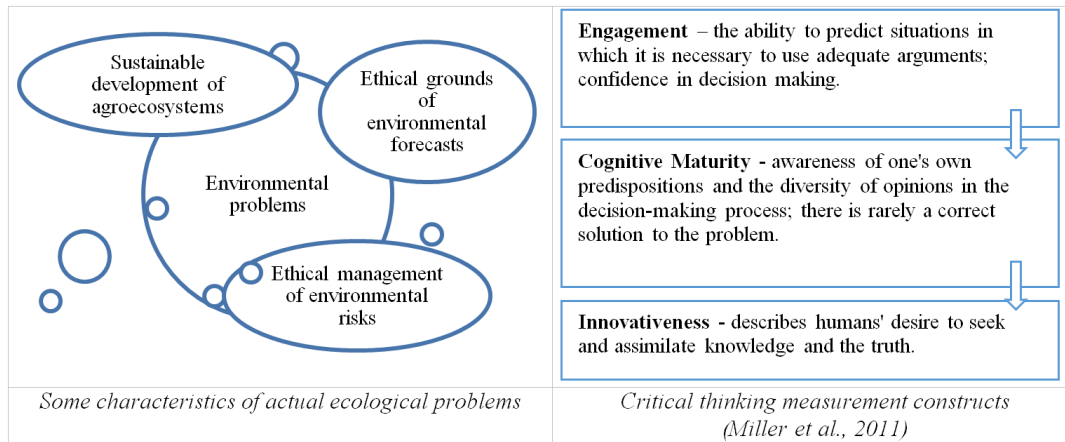


Fig. 1. Competence in environmental ethics – content elements (a) and stages of formation (b)



**Fig. 2. Conceptual highlights in the study**

**Table 1. Systematic data and descriptive statistics of the UF-EMI test with students**

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Engagement pre-test	98	31.00	46.00	40.449	0.320	3.176
Engagement post-test	98	35.00	50.00	43.122	0.367	3.633
Maturity pre-test	98	23.00	37.00	29.244	0.273	2.698
Maturity post-test	98	25.00	37.00	31.255	0.287	2.844
Innovation pre-test	98	11.00	25.00	20.744	0.302	2.989
Innovation post-test	98	15.00	28.00	22.030	0.298	2.948
Sum of scores pre-test	98	65	108	90.437	0.895	8.863
Sum of scores post-test	98	75	115	96.407	0.952	9.425

**Table 2. Statistical analysis (t-test, paired samples) of data from the UF-EMI test with students**

Paired differences		Mean	Std. Dev.	std. error mean	95% Confidence interval of the difference		t	df	Sign. (2-tailed)
Pair					Lower	Upper			
<i>Engagement</i>	pre-test post-test	0.673	2.551	0.257	3.185	2.162	10.372	97	0.000
<i>Maturity</i>	pre-test post-test	2.010	2.348	0.237	2.481	1.539	8.474	97	0.000
<i>Innovativeness</i>	pre-test post-test	1.286	3.809	0.384	2.050	0.529	3.341	97	0.001

a weak disposition to critical thinking (Duncan et al., 2016). The entire group (N=98) of students in this study would be classified as weak overall. Previous studies discovered similar results when students' critical thinking dispositions were determined by one or more of the following assessments: California Critical Thinking Disposition Inventory (CCTDI) and the Cornell Critical Thinking Test (Bataneh & Zghoul, 2006; Baker et al., 2000). According to Irani et al. (2007) typical ranges for EMI scores fall between 28-55 (*Engagement*), 16-40 (*Maturity*), and 15-35 (*Innovativeness*). Therefore, all students in this study fell within the typical EMI mean score ranges for all three dispositions (Table 1).

Regarding to the Innovativeness construct, no significant differences have been found between students' skills before and after the training course either between male and female. The two other constructs (*Engagement* and *Maturity*) showed a significant increase in the students' skills ( $p < 0.001$ ), more expressed at the *Maturity* disposition (Table 2).

The *Engagement* disposition measured students' predisposition to look for opportunities to use reasoning; anticipating situations that require reasoning; and confidence in reasoning ability (Duncan et al., 2016). The results obtained can be explained by the general addressing of the questions to the educational process itself and the students' commit-

ment to it, rather than to the specific environmental issues.

Cognitive Maturity (Maturity) disposition measured students' awareness of the complexity of real problems; being open to other points of view; and being aware of their own and others' biases and predispositions. The questions that provoke cognitive maturity are focused on the individual and his or her approach to addressing problems in general. They interpret their personal expression in dealing with critical situations/problem solving. These issues are more personalized, but also highlight the ability of the student to deal with external circumstances in a problematic situation.

The Innovativeness disposition measured students' predisposition to be intellectually curious and wanting to know the truth. Manifested criticism from students when considering environmental problems are synchronized with the age characteristics of young people to overcome the inconvenience in search of truth and the right decision. Young people are more aware that the environmental situation will have a very direct impact on their quality of life. This is related to their very good communication and teamwork skills, as well as their problem-solving skills, which have been emphasized at all levels of the education system in recent years.

## Conclusions

In conclusion, we could emphasize that EE, as a scientific and disciplinary field, provides adequate opportunities for: application of an ethical approach in solving environmental problems for sustainable development of the ecosystems; development of EE competence in student education; sophistication of the tools for solving problems and dealing with risks in the ecosystems (agroecosystems).

Our study brings three main *contributions*:

- It supports the enriching of environmental education with regards to the possibilities for regulating human-environment relations with the benefits of EE;
- it offers tools for solving environmental problems based on EE;
- it highlights possibilities for expanding the influence of EE for the formation of competence in EE as an important part of the development of coordinated skills in the professional ecologist.

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