

# A CROSS MODEL FOR ACADEMIC STAFF REGARDING BIO PLASTIC

**Grațiela Dana BOCA**<sup>1,\*</sup>, **Arzum ISITAN**<sup>2,\*</sup>, **Evren ÇAĞLARER**<sup>3,\*</sup>

<sup>1</sup> Department of Economics, Technical University of Cluj-Napoca, 76 Victoriei street, 450122 Baia Mare, Romania, [gratiela.boca@econ.utcluj.ro](mailto:gratiela.boca@econ.utcluj.ro)

<sup>2</sup> Department of Mechanical Engineering, Faculty of Technology, Pamukkale University, Kinikli Kampus, 20160 Denizli, Turkey, [aisitan@pau.edu.tr](mailto:aisitan@pau.edu.tr)

<sup>3</sup> Kırklareli University, Technology Faculty, 39100, Kırklareli, Turkey, [evren@klu.edu.tr](mailto:evren@klu.edu.tr)

\* Correspondence: [bocagradiela@yahoo.com](mailto:bocagradiela@yahoo.com), [aisitan@pau.edu.tr](mailto:aisitan@pau.edu.tr), [evren@klu.edu.tr](mailto:evren@klu.edu.tr)

**Abstract:** This study creates a cross model contributing to sustainable plastic management and suggests solutions for future role of universities and academic staff research in young generation orientation and environmental education. We define the importance for academic staff for sustainable plastic management and the environmental damage of plastic material. A survey was applied in same period and 271 academic staff from Turkey, Romania, Italy and Switzerland participates. The survey contains 47 items and was structure in more parts: individual characteristics (gender, age, academic title, country, field of specialization), knowledge about plastic, behavior regarding the dissemination of plastic information and needs (training, special lecturers, conferences, workshops). To be able to create the cross model we take in consideration a new variable for a better understanding of academic staff his/her awareness regarding the plastic waste problem. Our cross model results suggest that academic staff knowledge and needs influence their awareness regarding bio plastic and also academic staff awareness influence their behavior regarding the plastic phenomenon. There are no borders between countries and culture and information about plastic and recycling, as well as bio plastic it is very well know. Finally, we present a synthesis of the barriers and opportunities for academic staff in sustainable plastic management by universities. Barriers frequently mentioned were high costs and lack of new information. Further research should expand the survey, identify the enabling conditions for sustainable plastic management, and determine environmental impact for each country and realize a cross cultural model.

**Keywords:** waste management, bioplastic, plastic waste, recycle, environmental education

## 1 INTRODUCTION

Thanks to their educational mission, universities can make visible the topics related to plastic pollution and the benefits of using bio

plastic. They are also the incubators that are actively involved in research, development of new technologies. The academic staff has the potential to become and create models for the reduction and recycling of plastic waste. The

elimination of plastic pollution emphasizes the role of universities in the transformation of the plastics economy and their role in the transformation of the plastics economy. Situmorang et al (2020) mention that environmental education in universities is the most effective way to increase environmental awareness of students in plastic waste problem. Also Chuvieco et al(2019), Freije et al (2017), Ringle et al(2017) related to role of formal education to form environmental behavior previous studies mentioned that majors at university level are the affecting factors influencing the sustainable behavior of students.

Elmassah et al (2020) in Egypt, Wang et al (2020) among Chinese university, Estrada-Vidal et al (2017) and Hess and Maki (2019) present the importance of adaptation of curricula and staff involvement in recycling and plastic waste importance.

Education is already involving people in presentation of plastic waste and management waste. In India, the power of education, skills and determination pave the way for green jobs in the solar industry, and green jobs in turn create synergies between jobs and community and school education.

Budihardjo et al (2021) identified the concern for campus authorities in their efforts to manage campus waste. They observed that the only factor that significantly affects solid waste generation is student awareness. The results of this study could be used as a reference to develop sustainable campus strategies, recycling plans and comprehensive waste management in higher education.

Bennett and Alexandridis (2021) believe that educating the public and industry about plastic recycling can be done through recycling programs or by creating new programs.

Educational materials about plastic recycling are available not only through universities but also through professional and industry associations.

Thus universities, through university courses and short courses offered with private companies, emphasize the environment.

There is currently a shortage of plastic recycling courses offered at university level. Educating students about plastic recycling will equip them with the knowledge and skills to make informed decisions as consumers and implement plastic recycling systems professionally.

Abdulghaffar and Williams (2021) despite the various initiatives used to promote sustainability to achieve the 2030 Agenda globally, understanding of the practices, discourse and management of higher education institutions remains limited.

Aikowe and Mazancová (2021) and Park et al. (2022) identified the potential factors regarding the relevance of introducing waste sorting management practices in university campuses with the help of teaching staff through campaigns for waste sorting and recycling activities. The study population was composed of academic and non-academic staff.

The study identifies knowledge, attitudes and behavior regarding waste management and what could be done to develop sustainable practices on campus. Stojic and Salhofer (2022) in their studies showed that training and education play an important role in the development of individuals, organizations, regions and society in general.

Sallaku et al (2022) present a study identifying environmental concern, attitudes towards recycling, social norms, university environmental policy and availability of recycling facilities at higher education institutions as factors affecting recycling intentions/behaviors in institutions of higher education.

Yusuf and Fajri (2022) and Opeolu (2021) show that plastic waste and plastic pollution it is a global concern that must be addressed collectively, and here we can emphasize the role of universities, as the nursery of future

employees or leaders who will make the decisions for us in the future.

Singh Chauhan and Punia (2022), mention that education may also play an important role in changing consumer behavior and attitudes toward plastic waste management. Sandu et al (2021) sustain that educating society about plastic waste will provide people with awareness about the issue and the appropriate actions to be taken, and will motivate the people to help the environment.

In the view of Uehara et al (2022) and Hendrickson et al., (2011) the campus can be considered as a unit of social setting active on social networks, national but also international because it represents the place where students acquire and disseminate knowledge among fellow students various campus topics can be addressed through social media.

Parejo et al. (2021) offers a solution for stimulating students' awareness of plastic and the polluted environment by exposing the social responsibility of the educational institution as an agent of social change and development. The solution is the involvement, through activities, of students' knowledge by making materials from recycled plastic waste. By getting involved in projects, participating students can also be involved through the ecological perspective.

Martín-Núñez et al (2022) suggest the adaptability of online teachers as a solution for attracting students. Their study analyzed the perceptions of students who experienced the bimodal modality of a useful solution.

Martinez et al (2019) in their study pointed out that teachers do not yet have knowledge about plastic or plastic waste. So it is necessary for the first time to organize training programs for teaching staff, by addressing sustainability issues, competent and willing to teach such important subjects.

The integration of plastic issues into the educational system was studied by Dalu et al (2020) the issue that has been overlooked,

presenting a major challenge for environmental awareness.

However, the results indicate that plastic pollution has been integrated into the school curriculum in the subjects of technology, natural sciences, geography, life sciences, life skills and life orientation. However, there was a lack of integration of plastic waste management practices, understanding of the hazards, the need for educational awareness of the problem of plastic pollution with increased environmental programs needed to educate schools on management practices and impacts.

## 2 CASE STUDY

### 2.1 *Motivation of the study*

The present study can be considered as a reference for systematizing knowledge about recycling behavior in higher education and to further advance knowledge on this topic. University managers could use the conclusions of this study as a basis for designing education programs in the field, for curriculum innovation.

The originality of the work lies in the fact that previous researches focused on the attitude and behavior towards plastic waste among students or people at work, and this study addressed the behavior, needs and knowledge of academic staff towards the problem of plastic waste. The specialized literature about recycling behaviors in the higher education environment, reflecting the didactic failures of those who are going to educate students in awareness of environmental problems, has not been addressed.

Following the present study case we were trying to present the situation of academic staff in different from different countries, and identify how we can involve university as an important pillar in education of the future generation as citizens in sustainable environment.

A total of 217 academic staff from Technical University of Cluj Napoca, Romania, Pamukkale University and Kirkareli University from Turkey, University of Trento Italy and SUPSI from Switzerland. The academic staff participated through face-to-face interviews and online survey between June –July 2022.

The survey contain 47 questions and was structured in three parts:

- a) the first investigated the individual characteristics of the questioned individuals gender, age, education, university, and department;
- b) the second was structured for the purpose of scaling methodology on staff perception about the concept of plastic sustainability and their participation in different activities regarding plastic recycling;
- c) the third part identifies respondent’s behavior and attitude about bio plastic benefits.

### 3 RESEARCH METHODOLOGY

The information obtained presents us radiography of knowledge level regarding the plastic information and the impact upon daily life.

To determine the dimensions of academic staff behavior and identify their implication, needs about plastic and bio plastic knowledge’s an Explanatory Factor Analysis (EFA) is applied to the data set.

In this study, data and statistical processing were performed using the Statistical Package of Social Sciences software (SPSS) version 20 software package and Ringle et al (2015) Smart PLS program.

The purpose of the study has been conducted between academic staff to understand their behavior and awareness regarding sustainable environment and plastic products.

In this study, the following factors were taken into consideration: individual characteristics (age, gender, education grade, department), needs, knowledge and behavior.

A research model it is presented in Figure 1.

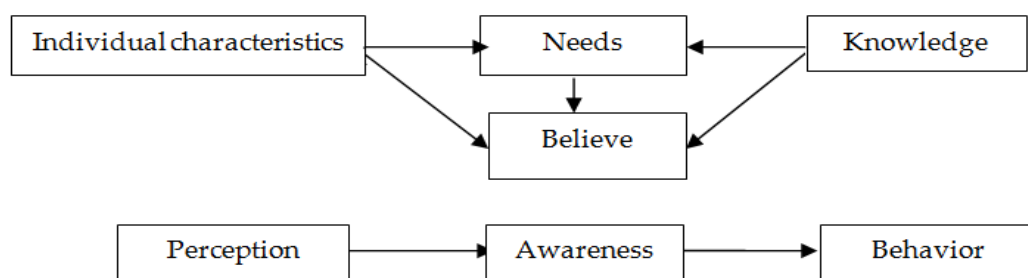


Figure 1. Research model

Cronbach’s  $\alpha$  coefficient values of 0.968 confirm the validity of data base obtain. A Likert-scale were used ranging from 1 ‘Totally Appropriate’ to 5 ‘Not at all Appropriate’, was applied on a face-to-face basis.

By independent samples *t* test, the hypotheses were tested using the SPSS statistical analyses software.

Hypothesis for the model given are as below:

H<sub>1</sub>: Academic staff Behavior towards bioplastic effect their Awareness;

H<sub>2</sub>: Academic staff Awareness towards bioplastic effect their Knowledge;

H<sub>3</sub>: Academic staff Needs toward bioplastic effect their Awareness.

The cross model for academic staff regarding bio plastic is presented in Figure 2 and the program Smart PLS solution regarding the connection between variables in Figure 5.

From the 47 questions of the questionnaire, we selected only 27 questions

that are directly related to the variable established for the academic staff model, these are the ones from Table 1.

The variables chosen for the model are:

1-Needs- (N1, N2, N3, N4, N5, N6, N7 and N8 questions);

2-Knowledge- (K1, K2, K3, K4, K5 and K6 questions);

3-Behavior- (B1, B2, B3,B4, B5, B6, B7, B7, B8, B9, B10, B11, B12 and B13 questions).

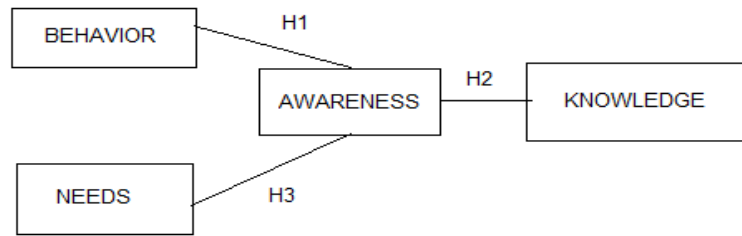


Figure 2. A Cross Model for academic staff regarding bioplastic

Table 1. Items for academic staff regarding bio plastic

Item	BEHAVIOR
B1	I think that I should be an example to my students about the use of bio plastics.
B2	I think that universities should cooperate with different institutions on bio plastics when necessary.
B3	I think that the use of bio plastic products is important in terms of sustainability.
B4	I think that bio plastic products should be used in agricultural studies.
B5	I think that countries should develop effective policies on waste management.
B6	I think that universities should carry out studies to raise public awareness about bio plastic.
B7	I think that awareness campaigns on bio plastic products should be organized.
B8	I think that more academic studies should be done on bio plastic.
B10	I think that bio plastic materials should be used in all areas within the university.
B11	When buying children's toys, I prefer bio plastic products.
B12	When I see plastic on the floor, I take it from there.
B13	When I talk to my students outside of class, I emphasize the importance of using bio plastics

Item	KNOWLEDGE
K1	I emphasize the importance of using bio plastic products in my classes.
K2	I sort recycling products in my office.
K3	Since bioplastics are produced from natural raw materials, they reduce dependence on petroleum.
K4	I use it more comfortably because bio plastic products do not contain petrochemical products.
K5	Bioplastic products do not harm human health
K6	I try not to include disposable products (plastic cups, forks, straws, etc.) in my life.

Item	NEEDS
N1	I prefer packaging that is not more harmful to nature.
N2	I prefer to use non-nylon bags while shopping.
N3	I prefer bio plastic products mainly because they are produced from natural raw materials
N4	I prefer bio plastic products as they do not cause carcinogenic effects.
N5	I prefer bio plastic products as they do not cause soil pollution.
N6	I prefer bio plastic products as they do not cause pollution of water resources.
N7	I participate in environmental events organized at universities
N8	I prefer bio plastic products as they do not cause air pollution.

## 4 RESULTS

### 4.1 Individual characteristics

The majority of staff is 58.1 % percent female and 41.9 % male. The majority of respondents 40.1% are between 40-49 years old and 25.8% percent are between 50-59 years old. The information obtained through the application of the survey is important because the staff belong to different departments namely science, literature and engineering, and their answers can be considered as an interesting feedback about the information with reference to bioplastics and which will have

relevance and the perception about the bioplastic topic will be seen exactly.

From Table 2 we can see that the respondents come from different specialties that have direct contact with plastic or not, where plastic and bio plastic is known and used or where the problem of plastic waste is very important. In equal percent 29.5% of respondents are from engineering and science (chemistry, physics, pedagogical education) and from economic department in 13.4 % percent. That's mean the human resources in universities in each country it is very well manage, and young generation participate active in academic life.

Table 2. In which department do you work

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
	Technical	64	29,5	29,5
	Letters	38	17,5	47,0
	Economic	29	13,4	60,4
	Physics	7	3,2	63,6
	Science	64	29,5	93,1
	Medicine	10	4,6	97,7
	IT	5	2,3	100,0
	Total	217	100,0	100,0

### 4.2 Academic staff knowledge

From Table 3 we can see the correlation between knowledge of the academic staff that influences their awareness of bioplastic. Academic staff in each country have knowledge and information about the effect of oil on nature. 96.3% percent of respondents believe that plastic waste is very important. Also a majority of 98.61 % percent of academics have knowledge about the impact of waste on the environment.

Most academic staff have individual perception and awareness of the problem of plastic waste and petrol. Only 55.30% of respondents believe that campaigns in each country about the importance of plastic waste would be beneficial. The plastic crisis is no longer an option, and plastic pollution is a serious issue of global concern. Countries engage in waste management dissemination campaigns and encourage universities to train and develop environmental education.

Table 3. Awareness campaigns on bioplastic products should be organized. \* I think that countries should develop effective policies on waste management.

		Totally Appropriate	Appropriate	Somewhat Appropriate	Not available	Not at all Appropriate	
I think that countries should develop effective policies on waste management.	Totally Appropriate	81	4	2	0	3	90
	Appropriate	16	19	2	0	1	38
I think that awareness campaigns on bioplastic products should be organized.	Somewhat Appropriate	1	3	11	0	3	18
	Not available	1	4	3	3	8	19
	Not at all Appropriate	0	0	0	2	50	52
Total		99	30	18	5	65	217

### 4.3 Academic staff participation

Table 4 shows the correlation between the belief of the academic staff and the involvement of the university in the activity of society.

A maximum value of 54.37% totally agree and agree with the role of the university to prepare and carry studies about bio plastic taking in consideration the public society awareness regarding the bio plastic.

A weak point was discovered regarding the staff participation to conferences from Table 5. 67 % percent from respondents consider that it is necessary a lot of time and qualify people to be educated on that subject. Organizing conferences and involve staff in multi-

disciplinary activities can be very successful and understand better the interdependence between theoretical problems and practice.

Thus this topic led to new ideas in research to find innovative solutions to replace plastic with bio plastic. The country and culture cannot be considered a barrier for the exchange of information and knowledge, thus 27.19% do not consider the importance of bioplastic and 10.59% respondents have no opinion.

The example must start from the teachers so that then the students will follow us, they being the ones who will later make decisions for us as well.

Table 4. I think that more academic studies should be done on bio plastic. \* I think that universities should carry out studies to raise public awareness about bio plastic.

		Totally Appropriate	Appropriate	Somewhat Appropriate	Not available	Not at all Appropriate	
I think that more academic studies should be done on bio plastic.	Totally Appropriate	75	12	2	1	0	90
	Appropriate	10	21	8	1	0	40
	Somewhat Appropriate	0	9	8	1	0	18
	Not available	2	1	4	8	7	22
	Not at all Appropriate	2	0	1	0	44	47
Total		89	43	23	11	51	217

Also 95.39 % percent from academic staff consider that they are environmentalist and it is very important especially now when the management waste it is a problem for our daily

life and nature academic staff before they are teachers they are educators of young generation and they can influence students behavior and attitude.

Table 5. I participate in environmental events organized at universities \* I think that universities should carry out studies to raise public awareness about bio plastic.

		Totally Appropriate	Appropriate	Somewhat Appropriate	Not available	Not at all Appropriate	
I participate in environmental events organized at universities	Totally Appropriate	40	8	4	2	1	55
	Appropriate	17	15	4	1	2	39
	Somewhat Appropriate	12	11	11	1	11	46
	Not available	15	5	2	3	14	39
	Not at all Appropriate	5	4	2	4	23	38
Total		89	43	23	11	51	217

#### 4.4 Academic staff behavior

Table 6 and Table 7 touches on the subject about academic staff behavior outside the class and lecturers with students. A percentage of 60.1% of respondents believe that it is not good to approach topics where they do not have all

the information and are not specialists even if it is an intense and recent topic.



Table 6. I think that more academic studies should be done on bio plastic. \* I think that countries should develop effective policies on waste management.

		Totally Appropriate	Appropriate	Somewhat Appropriate	Not available	Not at all Appropriate	
I think that countries should develop effective policies on waste management.							
	Totally Appropriate	77	6	2	0	5	90
	Appropriate	18	19	2	0	1	40
I think that more academic studies should be done on bio plastic.	Somewhat Appropriate	2	5	10	0	1	18
	Not available	1	0	4	5	12	22
	Not at all Appropriate	1	0	0	0	46	47
	Appropriate						
Total		99	30	18	5	65	217

Table 7. When I talk to my students outside of class, I emphasize the importance of bio plastics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally Appropriate	6	7,5	7,5	7,5
	Appropriate	10	12,5	12,5	20,0
	Somewhat Appropriate	12	15,0	15,0	35,0
	Not available	22	27,5	27,5	62,5
	Not at all Appropriate	30	37,5	37,5	100,0
Total		80	100,0	100,0	

The staff is aware and seriously involved in the use of bio plastic but they consider that first, traders must offer consumers reusable alternatives. The segment of the undecided and those on the sidelines of the pursuers is the same of 18.8 %. A 65 % from staff believes that people are not yet familiar with the subject and that it takes time to remove the plastic that has invaded everyone's habitat.

#### 4.5 Academic staff behavior

From Figure 3, with the help of the tree analysis, we observed that 59% of the academic staff in the countries under study are involved in the recycling process but also as an individual behavior. There are no boundaries between the

academic staff and the bio plastic solution in their daily life.

We can also observe that the country (culture) does not influence the perception of the academic staff regarding the use of bioplastic within the university but they can transform the role of universities so that they become a cultural educational generator for students. Instead only 28 % percent felt that universities should conduct studies to increase public awareness of bioplastics.

65 % percent of the academic staff emphasize that only qualified and specialized people can support the bioplastic issue with facts and information's. sustain with facts and information.

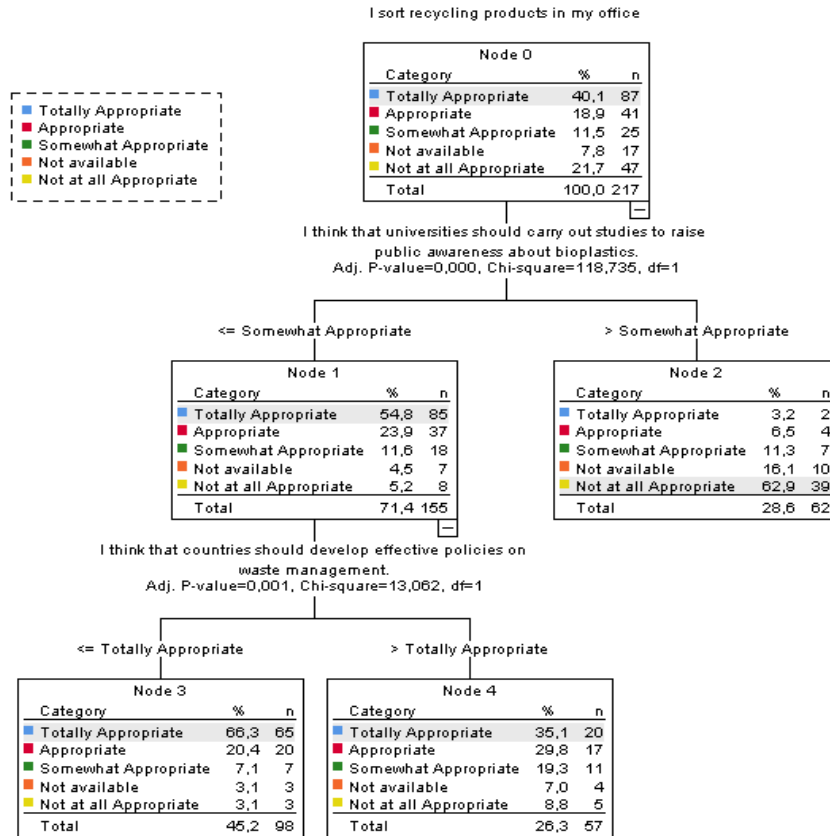


Figure 3. Classification and regression tree (CRT) results for academic staff regarding awareness and university role in waste management

Academic staff from Turkey, Romania, Italy and Switzerland are not interested in or participate in environmental protection or waste management activities, perhaps because their research and activities are primarily focused on their specialization priorities.

71.4 % percent of academic staff believe that plastic waste management is a priority in all countries and can be a good opportunity to implement policies to encourage people's awareness.

Academic staff are more optimistic about the involvement of universities in bioplastic studies, but on a personal level 88.7% of academic staff are not so optimistic considering

the time, cost and qualification required for such activities.

For 69,6 % percent it is important that universities play a major role in disseminating and educating the young generation in relation to new market trends.

From Figure 4 we obtain the necessary information about the staff that is or are not environmentalists.

71% of the respondents admit or believe that they are environmentalists and 21.7% admit that only sometimes being more comfortable.

Instead, in participatory life every academic is "European", following the rules imposed by

the countries of the European Union and adapting to the new trends of supporting bioplastic.

Only 61.3% of them participated in actions organized by universities on environmental issues, and 38.7% percent did not participate at events organized by universities because did

they not consider themselves environmentalists.

Among those who actively participate in thematic events, only 36.45 % agree with the campaigns organized to raise awareness among the population and 24.9 % are still undecided.

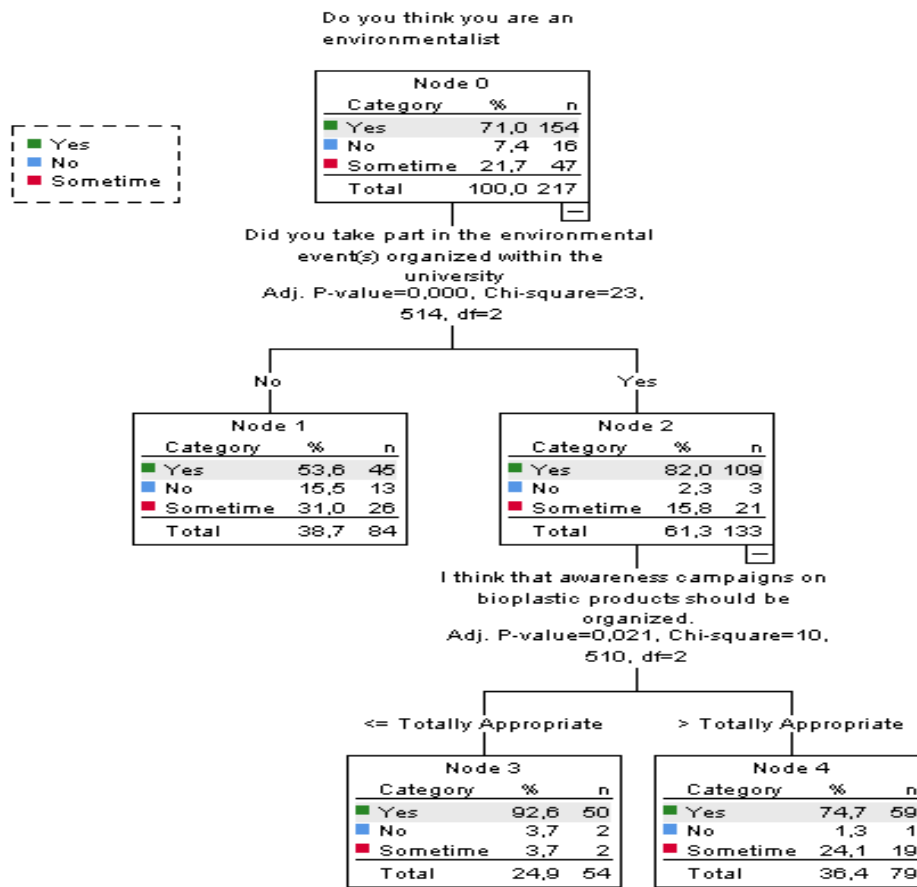


Figure 4. Classification and regression tree (CRT) results for academic staff awareness and ecological

## 5 A CROSS MODEL FOR ACADEMIC STAFF REGARDING BIO PLASTIC

Taking in consideration the data base after applying surveys to 217 academic staff from Turkey, Romania, Italy and Switzerland from different universities, to create the cross model

a special program were used. SmartPLS which is a software with graphical user interface for variance-based structural equation

modeling using the partial least squares path modeling method (<https://www.smartpls.com/>). Following Ringe et al. (2015), it was possible to establish the

purpose cross model. Transferring the database and using the SmartPLS, it was possible to select from 47 items 27 specific items present in Table 2, for variable taken in consideration

knowledge, needs and behavior of academic staff regarding bio plastic and the variable impact of staff awareness.

The cross model is presented in Figure 5.

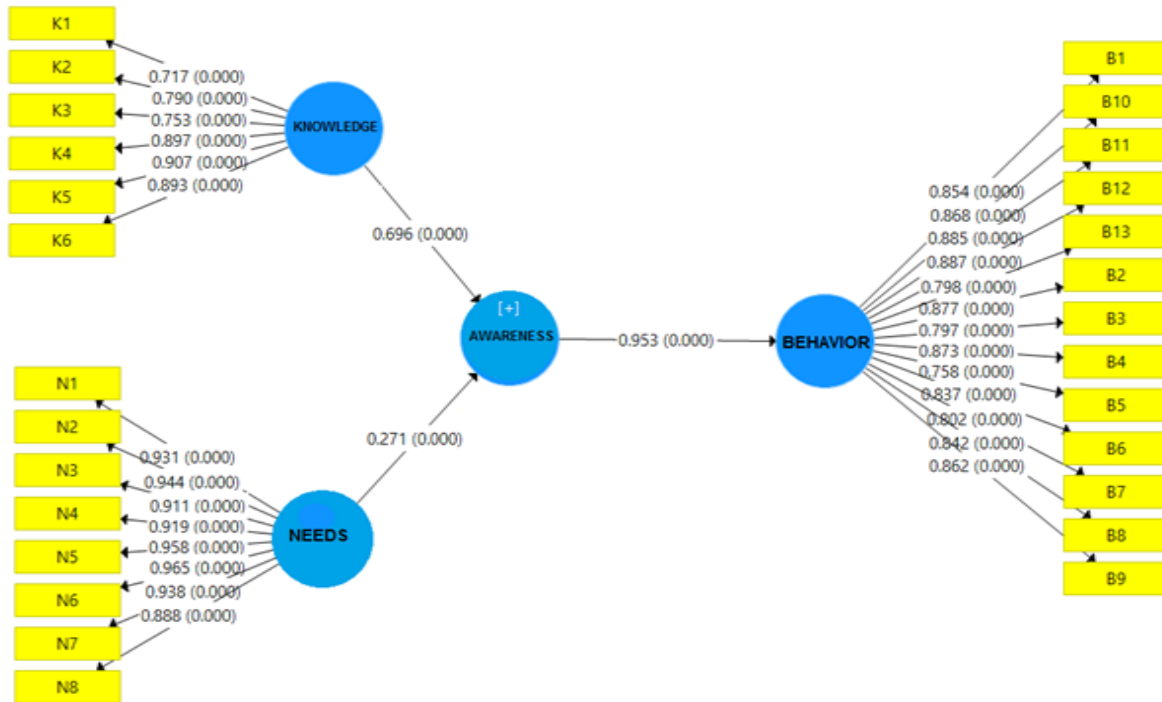


Figure 5. Correlation between factors influencing the academic staff behavior

Solution obtained for propose model for academic staff show a strong connection between awareness and behavior with a maximum value of 0.953 which influence in a positive way their attitude regarding bio plastic.

Academic staff from all countries are very well inform about plastic and new bio plastic, because the maximum values was obtain with 0.907 for item K5 " *Bioplastic products do not harm human health* " .

Awareness	Behavior	0.953	maximum	-
Needs	Awareness	0.271	-	minimum
Knowledge	Awareness	0.696	-	-

Because the connection between needs and awareness obtain a low value of 0.271 represent a weak point so staff must to be involve in different activities in and about environment and to participate or organize conferences, workshops on bio plastic topic.

So, awareness is influenced by the staff needs but also by their knowledge in field that definitively influences their behavior regarding plastic and the notion of environmental problems.

For connection between knowledge and awareness the value of 0.696 represent a strong connection between academic staff knowledge's from all countries and their influence upon their awareness. The only variables which can influence the behavior of people are knowledge and personal and society need.

Also they are very careful how they are recycling the product in work office for item K2 =0,717.

Academic staff also recognize that a need will be to put accent on more academic studies should be done on bio plastics show by the item N6= 0.965.

Model also shows low values of 0.758 obtain by item B5: "*I participate in environmental events organized at universities*" which it is a weak point.

The model establishes the correlation between factors influencing academic staff behavior; knowledge's and needs staff country (culture).

In conclusion the strongest connection it is between Awareness and Knowledge with the maximum value of 1.01, and near with same value of 0.97 Behavior lieve with Needs and Knowledge.

## 6 CONCLUSIONS

Case study on academic staff awareness, needs, knowledge and behavior regarding the bio plastic phenomenon are not influenced by the country of origin.

The cross model proposed in Figure 5 presents the following results:

- a) the knowledge of the academic staff influences the degree of awareness of the staff;
- b) the concern of the academic staff influences their behavior;
- c) academic staff needs influence staff awareness.

Respondents believe that it takes a lot of time and qualified personnel to be educated on this topic.

The identified strong points would be the academic staff is informed with reference to bio plastic, is individually involved in protecting the environment.

A weak point identified is the necessary involvement of staff in the organization of conferences and involvement in multidisciplinary activities.

Based on the data obtained, opportunities were also identified, such as the involvement of the respective universities and their successful staff in practical activities to ensure the interdependence between the theoretical and practical aspects.

The results show the following direction for the future:

- the involvement of universities in the well-being of society and students, thus transforming the university into a home;
- before being teachers, teachers are educators;
- involving students in the research activity in the volunteer activity through various methods and means;
- exchange of good practices between universities;
- teacher training;
- collaboration in organizing and participating in conferences on important topics;
- joint research groups.

Another solution to stimulate students' awareness of plastic and the polluted environment would be to involve, through activities, students' knowledge by making materials from recycled plastic waste. By getting involved in projects, participating students can also be involved through an ecological perspective.

The results of the study were used within the FUTURE Bio project to identify the level of

information and involvement of teaching staff in bio plastics and the identification of the necessary tools to stimulate them, such as:

- the creation of online platforms for theoretical courses;
- the virtual creation of laboratories;
- the use of digital platforms for the transfer of information between students without borders;
- mixed research teams on specific fields regarding bio plastic;
- the exchange of good practices between students and teachers.

### Acknowledgment

This study has been prepared within the scope of the FutureBio project (Erasmus+ KA220-HED-Cooperation Partnerships in Higher Education) supported by the Turkish National Agency and EU. "Funded by the Erasmus+ Program of the European Union. However, European Commission and Turkish National Agency cannot be held responsible for any use which may be made of the information contained therein"

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