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IMPORTANCE OF BIOETHICS IN ACADEMIC BIOTECHNOLOGY PROGRAMS IN MEXICO

Arturo F. Castellanos-Ruelas
Faculty of Chemical Engineering.
Autonomous University of Yucatán
Periférico de Mérida Licenciado Manuel
Berzunza, Mérida, Yuc. México

Ángel R. Pool-Cen
Faculty of Chemical Engineering.
Autonomous University of Yucatán
Periférico de Mérida Licenciado Manuel
Berzunza, Mérida, Yuc. México

Abner Fuentes-Bastida
Faculty of Chemical Engineering.
Autonomous University of Yucatán
Periférico de Mérida Licenciado Manuel
Berzunza, Mérida, Yuc. México

David A. Betancur-Ancona
Faculty of Chemical Engineering.
Autonomous University of Yucatán
Periférico de Mérida Licenciado Manuel
Berzunza, Mérida, Yuc. México

Luis A. Chel-Guerrero
Faculty of Chemical Engineering.
Autonomous University of Yucatán
Periférico de Mérida Licenciado Manuel
Berzunza, Mérida, Yuc. México

Abstract: Introduction and Objective In Mexico, one fourth of the universities that offer studies in Biotechnology Engineering do not include Bioethics in their curriculum of compulsory subjects. The objective of this work was to survey professors from the Autonomous University of Yucatan (UADY) to know the level of importance they attribute to the teaching of Bioethics, as well as their opinion on the relevance of incorporating it as a compulsory subject in the curriculum of the degrees, in particular Engineering in Biotechnology. **Material and Methods** A survey with 24 items was designed. The topics were: Section 1. Importance of Bioethics. Core part of the survey. Section 2. Teaching Bioethics. Punctual recommendation. Section 3. Knowledge of Bioethics. Thirty teachers were included in the survey in Mérida, Yuc. Mexico. The results were analyzed using descriptive statistics. **Results** Seventy five percent of the interviewees considered Bioethics important in the professional activity; in the research activities it was important for more than 70% of the participants. The data revealed that Bioethics should be included in the undergraduate programs including obviously Biotechnology Engeneering, according to 93% of the professors and in the case of postgraduate studies the need for its inclusion is 64%. **Findings** Bioethics must be included in the curriculum of compulsory undergraduate educational programs, especially in Biotechnology Engineering, since it is important for the professional performance and good judgment of graduate students.

Keywords: Teaching of bioethics, curriculum, biotechnology.

INTRODUCTION

The beginnings of Bioethics are recent, Van Rensselaer Potter being the first to use that word in the scientific field in the years 1970-71[1, 2]. It became popular due to the need to modulate the great and rapid advances in the moral and ethical field in Biotechnology and Biology registered in the world of science. By definition we can take the one proposed by Siluyanova and Pishchikova (2020) *"Bioethics is defined by the authors as a form of knowledge about the permissible limits of manipulating human life in the range from birth to dying"*[3]. This science was originally inspired by the Declaration of Helsinki issued by the 18th World Medical Assembly in Helsinki, Finland, in June 1964, referring to the ethical principles to be considered for medical research on humans.

Biotechnology has made amazing advances in recent years. The discovery of CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)[4,5], together with the CAS9[6,7] protein, has allowed us to understand and manipulate the bacterial defense mechanism against virus attack. This is achieved by controlling a genome exchange that can be used to introduce modifications into the cell. Its great possibilities to improve productivity have begun to be explored, for example to increase agronomic productivity; to design new treatments against diseases of man, plants and animals; to reduce the effect of climate change, etc. But it can also lead to undesirable developments, such as the creation of patentable organisms, vaccines owned by companies with only a commercial vision, among many others. The worst-case scenario would be to genetically manipulate man for political, profit, aesthetic, athletic, war, etc. purposes.

The presentation of a dichotomy between Biotechnology and Bioethics could lead to the dehumanization of this science. That is why

voices have been raised trying to modulate this technology[8]. The essential nature of developing critical thinking, especially in students, is highlighted to reinforce their reasoning at important moments of decision-making during scientific research.

In Mexico, undergraduate programs in Biotechnology Engineering were created, counting 19 programs in 2024[9]. The review of their curricula looking for those that included the subject Bioethics, Ethics or another similar subject, revealed that 73.6% did include it. That is to say, approximately a quarter of the programs ignored the importance of this discipline and did not consider it in their curriculum as a mandatory subject, leaving the subsequent professional behavior of the graduated students to chance.

The groups formulating the curricula for undergraduate degree in universities in Mexico should consult the faculty base about the relevance of including this or that subject, such as Bioethics.

Based on the above, a survey was carried out among the professors of the Autonomous University of Yucatán (UADY) with the objective of knowing the level of importance they attribute to the teaching of Bioethics and its future impact on professional performance of the students, as well as their opinion on the relevance of incorporating it as a mandatory subject in the curricula of undergraduate programs, in particular Biotechnology Engineering.

MATERIALS AND METHODS

This research was carried out between the years of 2018-2020, at the facilities of the Faculty of Chemical Engineering (FIQ) of the UADY, in Mérida, Yuc., Mexico. An online survey (instrument) was designed with 24 items distributed in five sections and a space for a final comment to be written in free text. The sections were:

First initial section. Identification of the teacher, being anonymous (items 1-6).

Second initial section. Academic Training in Bioethics. Courses taken by teachers in their professional studies (item 7).

Section 1. Importance of Bioethics for teachers. Core part of the survey (items 8-13).

Section 2. Teaching Bioethics. Specific recommendation (items 14-19).

Section 3. Knowledge of Bioethics. Brief academic evaluation of the teacher involved (items 20-24).

First, the validity of the instrument was measured by subjecting it to the scrutiny of UADY professors who were specialists in the area. Areas of improvement were found in the instrument related to the clarity of the text, the repetition of certain items and their length. Based on such opinions, its final version was adjusted and re-designed. Subsequently, the reliability (internal consistency) of the instrument was measured, applying it to a group of 15 teachers. Internal consistency was measured by applying Crombach's α test[10]. In its final version, a value of 0.80 was found, indicating that the instrument had good internal consistency.

The target population was the professors at the FIQ, where the degree in Biotechnology Engineering was taught. Nighty nine professors from various degrees were invited by means of a letter specifying the Internet URL to answer the online survey. The results obtained were analyzed and interpreted using descriptive statistics[11].

Finally, in April 2020, an online search was carried out in the main URLs of the universities and Technological Institutes of Mexico to count those that offer a degree in Biotechnology Engineering and their curricular framework was reviewed in search of the subject of Bioethics or similar.

RESULTS

The final sample was 30 teachers who answered the survey. They were informed of an Informed Consent letter, which they signed in agreement before joining the survey. They were distributed as follows:

Ten were women and 20 were men.

Nine were under 40 years old and 21 were equal to or over 40 years old.

Seventeen were Doctors, 9 Masters of Science and 4 undergraduates

Fourteen were career professors, 10 were professors-researchers and 6 had another type of job.

Nineteen were teaching classes in the Industrial Chemical Engineering degree, 6 in Biotechnology Engineering, 3 in Food Engineering and 2 in Industrial Logistics Engineering.

Twenty-three obtained their postgraduate degrees in Mexico and 7 abroad.

In some cases, respondents failed to answer certain questions or data was lost.

SECTION 1. IMPORTANCE OF BIOETHICS FOR TEACHERS

The results are shown in Table 1.

Seventy five percent of those interviewed considered Bioethics important in the professional environment (items 8 and 9); in research activities was important, for more than 70% of the participants (items 10 and 11). For 50% it does not represent a problem (item 12) and only occasionally (29% of opinions) could it represent an obstacle when carrying out research work. The response to item 13 made it clear that the majority of those interviewed had little experience working in research related to Bioethics.

In general, women attributed greater importance to Bioethics than men, as did those professors who had a higher academic degree (items 8, 10 and 11); Age did not seem important in this differentiation. It is notable that women did not consider Bioethics an obstacle in conducting research (item 12).

SECTION 2. TEACHING BIOETHICS

The general responses of the evaluation on the importance of teaching and establishing Bioethics in academic life in shown in Table 2.

The data revealed that Bioethics should be included in undergraduate programs, including Biotechnology studies (item 15: 93%) and in the case of postgraduate studies the need for its inclusion is noticeably lower (item 14: 64%). The vast majority (item 16: 92%) thought that Bioethics application campaigns in the professional field should be reinforced. No positive attitude was observed among the teaches surveyed to participate in a Bioethics committee (item 17: 43%), possibly associated with their response in item 13. Finally, it was considered that bioethical codes should be established on each UADY Campus (item 18 : 79%). In the case of the professor's own workplace, only 32% of those interviewed foresee problems in academic work due to implementing Bioethics codes (item 19).

Women considered the inclusion of Bioethics in educational programs to be more important compared to men, as did teachers with a higher academic level, and people aged 40 or over (items 14 and 15). This trend is similar in its perception of incorporating Bioethics campaigns in the workplace (item 16). Women stated that they were more proactive in participating in the integration of Bioethics committees and that there should be Bioethics codes on the various University Campuses and in their own workplace (items 17, 18 and 19). Academic training and age show fewer differences between the teachers in these three items, except in item 19 where those over 40 years of age consider the establishment of a Bioethics code in their own

Item	Response option	Result in the evaluation	Gender		Academic level			Age (years)	
			♂	♀	PhD	MSc	Other	<40	≥40
8.- In your professional area how relevant is Bioetics?	Very important	57	42	89	69	83	40	56	58
	More or less	18	21	11	17	10	30	22	16
	Little	18	2		12	7	20	22	16
	I have no idea	7	11			2	10	10	
9.- Do you think that bioethics is currently considered important in the professional area?	Very important	57	42	32	57	59	67	33	42
	More or less	18	21	37	31	33	22	56	26
	Little	18	26	21	8	8	11	11	16
	I have no idea	7	11	10	4				16
10.- In research practice, what is the current importance of bioethics?	Very important	39	37	89	68	72	45	67	47
	More or less	36	31	11	23	21	23	22	26
	Little	14	16		7	7	22	11	11
	I have no idea	11	16		2				16
11.- In research practice which should be the real importance of Bioethics	Very important	46	84	100	98	100	80	100	84
	More or less	25							
	Little	18			2		20		
	I have no idea	11	16						16
12.- Is Bioethics an obstacle for scientific research?	No	50	37	78	67	57	80	67	42
	In some cases	29	32	22	22	43		11	37
	Yes	21							
	I have no idea	0	31			8	20	22	21
13.- Have you participated in research involving Bioethical issues?	Many times.	21	16	33	47	42	67	45	32
	Few times	43	26	56	37	33		22	21
	Never	36	58	11	16	25	33	33	47

Table 1. Importance of Bioetics for the teachers included in the survey (%)

Item	Response option	Result in the evaluation	Gender		Academic level			Age (years)	
			♂	♀	PhD	MSc	Other	<40	≥40
14.- Do you believe that bioethical aspects should be included in postgraduate training programs?	Yes.	64	58	78	66	91	60	44	74
	Depends on the program								
	No.	36	42	22	34	9	40	56	26
15.- Do you believe that bioethical aspects should be included in undergraduate training programs?	Yes.	57	47	78	68	75	50	44	63
	Depends on the program.	36	42	22	30	20	50	45	32
	No.	7	11		2	5		11	5
16.- Do you consider it important to reinforce, through campaigns or programs, the impact that Bioethics has in the professional or work environment?	Yes.	61	53	67	40	100	75	25	78
	Depends on the professional or work environment.	31	37	22	47		25	63	17
	No.	8	10	11	13			12	5
17.- Would you participate in a Bioethics committee for the development of research?	Yes	43	37	56	62	53	75	56	35
	Eventually yes.	32	26	44	23	35		22	37
	No.	25	37		15	12	25	22	26

18.- Do you believe that the UADY should have a "Bioethics Code" on each of its Campuses, similar to the one in the "Hideyo Noguchi" Regional Research Center of the UADY? (Health Sciences).	Yes, one for each area of knowledge.	79	68	100	86	86	100	67	84
	No, Hideyo Noguchi's is enogh.	21	32		14	14		33	16
19.- Do you consider that authorizing a Bioethics code in your own Unit could cause problems in the professional performance or research of your colleagues?	No.	68	58	89	71	82	82	89	58
	In some cases	32	42	11	29	18	18	11	42
	Yes								

Table 2. Importance of teaching and establishing Bioethics in academic life, for the surveyed professors (%)

Item	Result in the evaluation	Gender	Academic level		Academic level			Age (years)	
			♂	♀	PhD	MSc	Other	<40	≥40
20. The term Bioethics was coined approximately A. In the '70s	Correct	75	79	67	84	71	100	78	74
	Incorrect	25	21	33	16	29		22	26
21. The Declaration of _____ established the foundations of bioethical principles for medical research on human beings. R. Helsinki	Correct	71	47	87	88	33	50	78	67
	Incorrect	29	53	11	22	67	50	22	33
22.- Are you familiar with the term informed consent? R. Information initially provided to the participant related to his or her participation in the research.	Yes (correct)	61	53	78	89	63		67	54
	No (incorrect)	39	47	22	11	37	100	33	66
23.- Based on your knowledge of Bioethics, how would you define the principle of autonomy? R. It supposes capacity for discernment, freedom and coming of age	Correct	57	48	78	83	63	43	67	53
	Incorrect	43	52	22	17	37	57	33	47
24.- Based on your knowledge of Bioethics, how would you define the principle of beneficence? R. Moral obligation to do good to others	Correct	32	42	11	46	40	75	22	37
	Incorrect	68	58	89	54	60	25	88	63

Table 3. Evaluation of knowledge about Bioethics in the teachers surveye (%)

department to be less important.

SECTION 3. KNOWLEDGE OF BIOETHICS.

The results of the evaluation of knowledge about Bioethics by the participants are shown in Table 3.

By assigning 2 points to each correct answer, all participants obtained a score of 5.6/10 in this brief evaluation of their knowledge of Bioethics. This indicates that the participants did not have a solid preparation in this area of knowledge.

The above may be a consequence of the fact that the analysis of the results of question 7 indicated that the participants had only taken 1.6 courses related to Bioethics or Ethics during their professional training, which may be considered insufficient.

More women obtained better grades, as did those who studied postgraduate studies and those under 40 years of age.

COMMENTS IN FREE TEXT

Sixteen responses were obtained. The majority of those interviewed emphasized the importance of teaching Bioethics in professional and academic performance (individuals identified as A, B, C, D, E, H, J, K, L, M and P). "*At the undergraduate level it is mandatory and at the postgraduate level it is desirable*"; "*Necessary*"; "*Fundamental*"; "*In Mexico our professionals lack a lot of Bioethical education,*" among others.

Only two acknowledged that they did not have elements to give an opinion (subjects F, I and N). "*No comment*"; "*The truth is, I don't know much about bioethics*"; "*I don't know it.*"

One expressed complementary idea (subject G). "*I think there should be only one type of ethic.*"

Finally, subject O expressed the difficulty of being governed by ethics or bioethics due to the historical moments that people or different cultures are experiencing. "The great problem of being governed by an ethical or bioethical code is, in its origin, the same. What is allowed by ethics in one place is not allowed in another."

DISCUSSION

The updated review of educational programs that offer a degree in Biotechnology Engineering in Mexico lists 28 institutions. To the 17 registered by CONAHCyT in 2017, 11 more have been added to date, of which 9 are public institutions and 2 are private. Twenty-seven-point seven percent of the new programs consulted do not offer subjects associated with Ethics or Bioethics in their curriculum of mandatory subjects. This percentage was not very different from the 23.5% observed in 2017. This significant percentage of degrees that do not include Bioethics in the curriculum contrasts with the importance that this survey confers on Bioethics as an important subject to take into consideration.

Other authors have expressed concern about the dissociation between ethics and biotechnology. They express that there should be an "*alliance between health ethics and biotechnology financed by the international community, establishing policies in international organizations*"[12]; or that "*personalistic ethics is the one that best consider and value the person*" [13] in the face of the threat of dehumanized Biotechnology.

CONCLUSIONS

The study revealed that the sample of UADY professors had an incipient theoretical knowledge of Bioethics. They also had little experience participating in research work involving Bioethics concepts. However, they recognized that Bioethics is very important in the professional environment and also in research activity. For half of those surveyed,

the concepts of Bioethics do not represent any problem in carrying out scientific work. 93% expressed that Bioethics should be included in undergraduate programs, especially in Biotechnology, and the majority supported its inclusion in postgraduate curricula. Finally, they considered it pertinent to establish a Bioethical code on the UADY Campuses related to the disciplines taught there. Women, postgraduate professors, and professors under 40 years of age gave more favorable opinions in the survey about the implementation of Bioethical measures in studies, compared to their counterparts.

CONFLICT INTEREST

No conflict of interest declared

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