

# Curricular influence and perceptions of engineering graduates on socio ethical issues related to Biotechnology

Savithri Bhat and Rajyalakshmi M\*

Department of Biotechnology, BMS College of Engineering  
Bangalore, India

email: mrlbmsce@gmail.com, hod.bt@bmsce.ac.in

\*author for correspondence

**Abstract**—The impact of BT is on all strides of mankind, the fallout of which is the skepticism about social acceptance of BT products and processes. With appropriate subject knowledge the perception of an individual in this regard will undergo radical transformation. In view of this, ethical and safety issues related to BT are introduced as component of core courses in the curriculum of Biotechnology Engineering education. The present study involves survey pertaining to socio ethical aspects. The survey was conducted on biotechnology engineers, graduated over a period of seven years (2006 to 2012). The responses obtained indicated the ability of the graduates to judge a complex situation related to ethics in BT. Also, responses of the graduates displayed high level of social awareness and responsiveness.

**Keywords**— ethics; Biotechnology; social responsibility; survey; engineering graduates

## INTRODUCTION

Twenty first century is acclaimed to be the century of biology. But, the question is whether we are ethically ready? Biotechnology and genetic engineering is all about gene therapy, GMO foods, Norplant's, transplants, stem cell research and so on which are of immense benefit to mankind [1-4]. On the flip side are inhuman experimentations, terror gases, fetal research and human cloning [5-8].

News such as "Pharmaceutical industry used prisoners for testing their drugs as the prisoners were much cheaper than chimpanzees." are disturbing. An experiment conducted on Guatemalans involved intentionally infecting humans with syphilis organism to test effectiveness of penicillin [9].

Young minds need to be tailored for apt decision making and judgment [10,11]. Incorporation of ethics as compulsory course is essential in Biotechnology engineering curriculum [12].

The course content should include case studies as a large part and Socratic Method of instruction will enhance the understanding and practice of ethics.

A student's personal reflection on complicated issues which are intrigued with multiple aspects need to be perceived to get feedback on the instructed course. The ability of the student to judge a situation and combat with it will be reflected in surveys consisting of few performance indices. In the

existing scenario, the present study is planned to judge the socio ethical responsiveness of the BE-BT graduates with the several performance indices and the results are analyzed and interpreted.

## METHODOLOGY

BE Biotechnology syllabi of BMS college of Engineering includes several courses incorporated with guidelines on safety and regulatory aspects pertaining to BT. The table I depicts the various courses and their content pertaining to ELSI (Ethical, legal, social Implications) of BT product and process development and entrepreneurship, apart from bioethics and biosafety as core course offered in higher semesters. The course appraises the students on issues related with regulations in R & D, transfer of technology, bio business, human rights, societal acceptance of BT products, etc. Thus students by the end of their course will have comprehensive view on every aspect of ethics and safety. Further, one of the Program Educational Objectives (PEO) set for the BE biotech program was the socio-ethical responsibility of graduates.

TABLE I. COURSE AND THEIR CONTENT PERTAINING TO ELSI OF BT PRODUCT AND PROCESS DEVELOPMENT

Sl. No	Course	Content pertaining to ethics and/or safety
1	Pharmaceutical BT	Guidelines for new drug development and release, FDA, European regulation, ICH, Indian regulation
2	Management & Entrepreneurship	Problems of entrepreneurship, issues related to women entrepreneur, support and policies for SSI, effect of WTO, GATT etc
3	Genetic Engineering	Ethical issues related to cloning, GMOs, gene therapy and their societal acceptance
4	Animal Biotechnology	Ethical and legal issues on development of transgenic animal and IVF in human
5	Health Diagnostics	Clinical trials and clinical research regulations and policies
6	Diary BT	National and international regulation on food quality and safety aspects

To assess socio ethical responsiveness of our graduates, several queries (Table II) were put to BT alumni via online survey tool (www. monkey survey.com). The number of

alumni responded to the queries were 74 (N) and the responses collected are graphically represented.

TABLE II: QUERIES OF THE SURVEY CONDUCTED ON GRADUATES IN BIOTECHNOLOGY ENGINEERING

Sl No.	Query	Answer options
1	In your opinion, a life saving drug should be patented for	5 years 10years 20 years Never
2	Cloning of humans and animals should be	Approved Approved with restriction Disproved
3	Attitude of multinationals not developing drugs for rare diseases due to high cost of production and low returns	Favor Disfavor
4	Have you donated blood individually or in a blood donation camp	Yes No Not eligible for various reasons
5	Have you offered charity or fund for social causes	Yes No Once
6	Have you signed or sent emails towards social causes involving atrocities towards women or children	twice More than twice Never

## RESULTS AND DISCUSSION

As given in the table six performance indexes were taken for assessing the socio-ethical responsiveness of the graduates. The results were (total of 74 responses) tabulated (Table III) and were graphically represented in Figure 1-6.

TABLE III: THE RESULTS OBTAINED FROM THE SURVEY OF 74 RESPONSES

Sl No.	Query	Answer options	Responses in percentage
1	In your opinion, a life saving drug should be patented for	5 years	35
		10years	22
		20 years	12
		Never	35
2	Cloning of humans and animals should be	Approved	6
		Approved with restriction	59
		Disproved	35
3	Attitude of multinationals not developing drugs for rare diseases due to high cost of production and low returns	Favor	21
		Disfavor	79
4	Have you donated blood individually or in a blood donation camp	Yes	58
		No	22
		Not eligible	20
5	Have you offered charity or fund for social causes	Yes	72
		No	28
6	Have you signed or sent emails towards social causes involving atrocities towards women or children	Once	28
		twice	34
		More than twice	7
		Never	31

Query no 1: "Fig. 1" depicts the alumni responses for their opinion on "whether a lifesaving drug be patented for prolonged years". About 35% responded for the drug to be never patented and another 55% favored patent for a very short period, i.e 5 / 10 years. Currently a new drug is given 20 years of protection in many countries. Few countries grant additional protection up to 5 years. From the responses obtained it can be inferred that the students are aware of the huge costs involved in drug discovery, clinical trials and approvals. The responses also indicate that the students are aware of the prolonged years and low success rates of a drug development process.

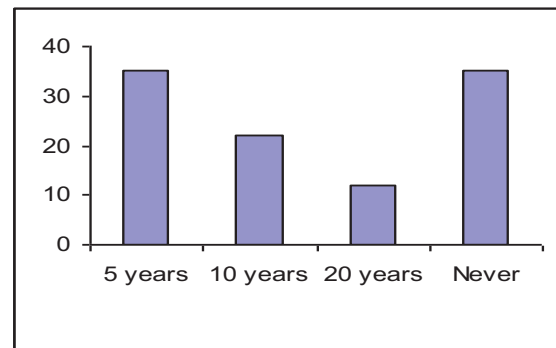


Fig.1: The alumni responses in percentage for their opinion on "whether a lifesaving drug be patented for prolonged years"

Query no 2: "Fig. 2" depicts responses of the graduates on the issue of approval for human cloning. The results indicate that 94% of them disapprove or approve with restriction, indicating their awareness towards the negative implications of human cloning at the same time their awareness on the application of animal cloning in human organ transplantation.

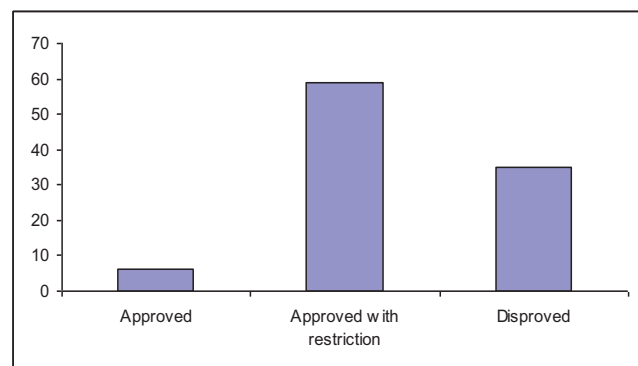


Fig. 2: Alumni responses in percentage on the issue of approval for human cloning

Question No 3: "Fig. 3" depicts the responses on the issue "Attitude of multinationals not developing drugs for rare diseases due to high cost of production and low returns". Majority of the students were in disfavor displaying social concern for the sufferers of rare diseases.

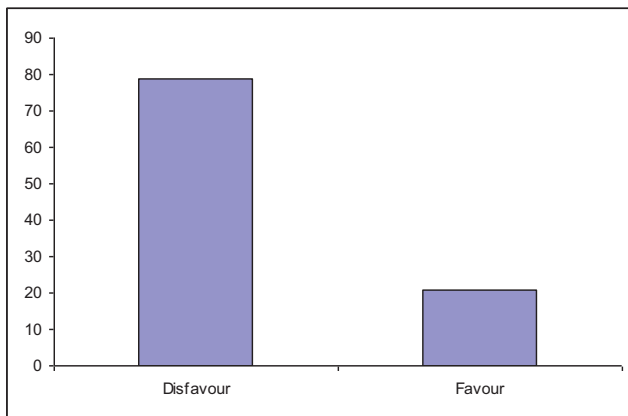


Fig.3: The alumni responses in percentage on the issue of Attitude of multinationals not developing drugs for rare diseases due to high cost of production and low returns

Question No 4: "Fig. 4" depicts the responses on the issue whether they have donated blood individually or in a blood donation camp, about 58% were affirmative and 22% were not eligible for the donation. This reflects that the graduates have concern towards the needy patients.

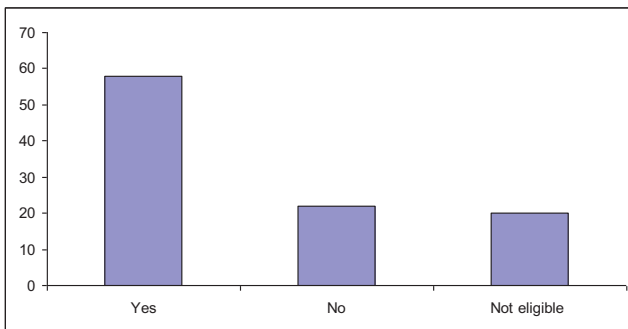


Fig. 4 The alumni responses in percentage on whether or not blood been donated

Question No 5: "Fig. 5" depicts that majority of the graduates donated for a social cause. About 70% of graduates have donated for social cause.

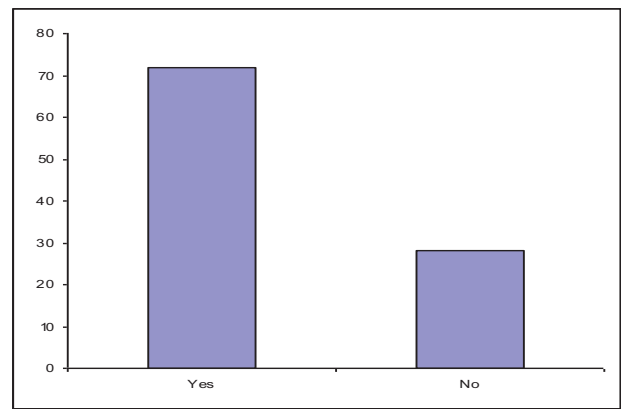


Fig. 5: Alumni responses in percentage on whether or not donation done for social cause

Question No 6: "Fig. 6" depicts that majority of the graduates have signed for a social cause. More than 65% of graduates have signed for social cause at least once.

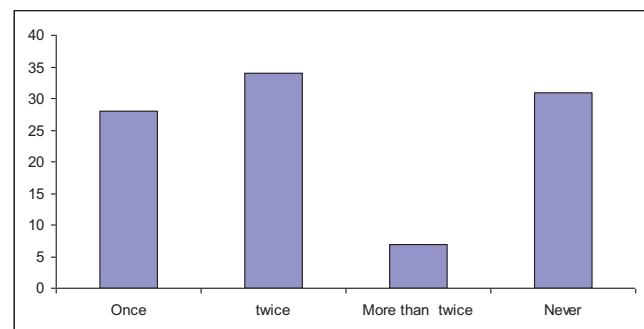


Fig. 6: The alumni responses in percentage on whether or not The graduate ever signed for social cause.

#### Discussion:

In a long term study to determine if a Biotech course influenced students' knowledge, acceptance of risk and ethics in biotechnology, survey was conducted at the starting day and ending day of a 13 day- Biotechnology awareness course over ten years. The authors concluded that the responses obtained reflected increase in subject knowledge and better perception on the GMO products, but no compromise in the Ethical attitude [13]. In concurrence, our graduate study results reflected the responsiveness of students to the social issues and acceptance to some extent on the issues involving fetal research and showed no compromise on ethical issues. Studies conducted on students from 11 Western Australian schools on acceptance of BT products derived from organisms, the percentage of acceptance for the use of microorganisms is higher than that of humans and animals [14]. Yet another Europe wide study conducted (2005 & 2010) to assess „the Levels of approval for embryonic and non-embryonic stem cell research and gene therapy' the

authors noted increase in the percentage of people accepting the embryonic stem cell research under strict laws of regulation (from 36 to 51) [15]. In accordance are the responses of our graduates towards animal cloning wherein, 94% disapprove or approve with restriction.

In conclusion, since many a times social and ethical issues are complex and subjective to a particular scenario, substantial subject knowledge is advantageous to arrive at an appropriate decision

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