



Research Article

Awareness of students on genetically modified organisms in a state university: Basis for a proposed university awareness program

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ABSTRACT

As an educational institution, there is a need to be well informed especially about pressing issues and concerns affecting humanity and one such issue is on the genetically modified organism. GMOs are organisms that have gone through some genetic alterations. It has become a business that may have started with good intentions, but that which have been described by experts as something that can also affect large numbers of people in yet unforeseen ways, that some are not even aware of the fact that they are consuming GMO food.

The study aimed to find out the level of awareness of Technology and Livelihood Education students in a State University in Region 02 on Genetically Modified Organisms with the hope that many people will acquire knowledge for the development of the community. It made use of the quantitative descriptive-inferential approach using a questionnaire checklist validated by experts. Weighted mean and Analysis of Variance were used to analyze the data gathered.

Findings show that most of the respondents have a low level of awareness on genetically modified organisms in food products and have a very low level of awareness in terms of genetically modified

plants, animals, medicine, and the possible health risks these can bring about. Furthermore, findings reveal that there is a significant difference on their level of awareness in terms of genetically modified food products, plants, animals, medicines. With the findings and conclusions gathered, there is a great need to raise the level of awareness of the respondents on genetically modified organisms. Thereby, the researchers proposed the University Awareness Program on genetically modified organisms making every student in the university fully aware of the issue of GMOs.

Keywords: *Barriers; Usage; Interactive technology learning tools; Information & Communication Technology; Faculty*

1. INTRODUCTION

It is a fact that human beings these days have a short lifespan. Various diseases and viruses which earlier have not been known to humankind are now bringing fears and causing occasional great alarms as more and more people get suddenly sick. Can this be attributed to humanity's wanton destruction of the original state of the environment in exchange for material gains? Or for whatever reasons, are the modifications and alterations in the environment justifiable? Above all these ethical questions is the issue, how aware are we as an educational institution?

Somewhere, somehow, as an educational institution, there is a need to be well-informed, especially about pressing issues and concerns affecting humanity. Hence, research is a very helpful tool for educators, students, administrators to gauge the level of knowledge on these pressing topics, one of which is the issue of GMOs. GMO is an abbreviation for "genetically modified organisms." It means that an organism has gone through some genetic alterations. Transgenic organisms, a subset of GMOs are the constituents of modified foods. This process was first used in biological and medical research to produce genetic medicine and pharmaceutical drugs, and this started to be used by various sectors especially those devolved in agriculture and food production (McGloughlin, 2016). Countries that grow GM crops include Argentina, Australia, Canada, China, Germany, India, Indonesia, Mexico, Portugal, South Africa, Spain, United States, Ukraine and many more (Integrated Regional Information Networks, 2017).

Through this study, the researcher believes that every consumer must be aware of their rights to choose and to be informed and that there should be complete transparency and accountability in terms of the food and drugs and the alterations conducted greatly affecting all concerned individuals.

In this vein, the researcher decided to conduct an assessment on the awareness of technology and livelihood education students in a state university in Region 02 on Genetically Modified Organisms (GMO) with the hope that many people will acquire knowledge for the development of the community. The study aimed to find out the level of awareness of Technology and Livelihood Education students on Genetically Modified Organisms.

Specifically, this study tried to answer the following questions:

1. What is the level of awareness of the respondents as to Genetically Modified Organisms in terms of:

- 1.1. Food Products;
- 1.2. Plants;
- 1.3. Animals; and
- 1.4. Medicinal Products?

2. What is the level of awareness of the respondents on the health risks of Genetically Modified Organisms?

3. Is there a significant difference between and among the level of awareness of the respondents as to Genetically Modified Organisms in terms of:

- 3.1. Food Products;
- 3.2. Plants;
- 3.3. Animals; and
- 3.4. Medicinal Products?

4. What program can be conceptualized considering the findings and result of the study?

Along with the noble desire to combat hunger, poverty, and diseases in developing and applying such technology, scientists have the task of protecting the rest of creation from all possible harms that could ensue. Genetic engineering is acceptable only if all risks are minimized (H. Daniel, 2017). Otherwise, one may easily succumb to temptations of productivity and profit at the expense of the people and environment. And as long as foreseeable dangers are not fully identified, studied, and avoided, safe alternative procedures should be used, or if none, testing and development of the technology should be delayed altogether (Thompson, 2016).

The following hypothesis was tested in the study:

- 1. There is no significant difference between and among the level of awareness of the respondents on genetically modified organisms in food products, plants, animals, and medicine.

2. LITERATURE REVIEW

Critics have objected to GMOs on several grounds, including the tampering with nature, ecological concerns, economic concerns raised by the fact that these organisms have been often subjected to intellectual property law, or have been patented, unmindful of the fact, whatever food produced as GMOs should be banned or labeled, whether such food is safe, and whether GM crops are useful to address the world's food scarcity problem (M.A. Altieri, 2015). GMO has become a business that may have started with good intentions, but that which have been described by experts, as something that can also affect large numbers of people in yet unforeseen ways. Most of the GM crops grown today have been developed to resist certain insect pests. Genetically Modified (GM) plants are being developed today to produce specific vitamins, resist plant viruses, and even produce products for medical uses (Monsanto Company, 2015).

Now, GMO products are widely spread and the risk of using them no longer involves a small number of people in need of treatment for specific diseases or a small number of experimental lab animals but rather multitudes of people all over the world. Some are not even aware of the fact that they are consuming GMO food (Digal, 2017). Eventually, the idea was used on animal food stocks. The use of genetically modified organisms has resulted in a big controversy between advocates who believe that it is a human development that can minimize hunger in the world and adversaries who think that this is a serious tampering with nature and that will only witness its dire results many years down the road, and that it might be much too late by then.

Global agriculture finds itself engrossed in heated debate over genetically modified (GM) crops. This debate, which features science, economics, politics, and even religion, is taking place almost everywhere. It is going on in research labs, corporate boardrooms, legislative chambers, newspaper editorial offices, religious institutions, schools, supermarkets, coffee shops, and even in private homes (Sin, 2015). The Philippine agriculture has the poorest record among the world's leading tropical countries. The sector advanced at only 1% a year in the 1980s and 1.5% and 3.1%, while Vietnam grew by 4.3% and 5.1% respectively (Global Knowledge Center on Crop Biotechnology, n.d.)

At the same time, the Philippine population grew and is still growing at an annual average rate of 2.3% or – in other words – it is doubling its population every 30 years. As of today, the Philippines counts about 78 million people. Only 10 years from now, there will be 100 million Filipinos, 22 million more mouths to feed than compared to today. One must not be a mathematician to recognize that the actual growth of the Philippine agriculture sector cannot keep pace with the population increase. Subsequently, to ensure food security, food imports, not only for rice, but also for sugar and other food items are steadily increasing. The food and agriculture Organization of the United Nations (FAO) defines food security as “access by all people at all times to the food required for a healthy life” (Martel, 2015).

Access also implies affordability. One has to keep in mind that the ordinary Filipino household is spending up to 59% of its monthly income on food alone compared to 10% to 15% only in developed countries. Strategies that aim to further increase prices for food are irrational because they threaten Philippine food security and actually just put farmers of Thailand, Vietnam and other foreign countries at an advantage because they are able to produce food cheaper than Filipino farmers do. The proper response is to increase agricultural productivity without jeopardizing the natural resources – water, soil, air and biodiversity (Monsanto Company, 2015).

Food is a vital source for the survival of mankind. The current global food crisis has become too significant a problem that we cannot avoid this issue any further. Several solutions are made to salvage the situation like educating the nations on eating habits, controlling population and providing food and financial aid to poor countries that face hunger and famine. However, enforcing birth control and changing eating habits is possible but difficult to change the mind-set of billions of people within the near future; what we need is an immediate response to tackle this exponentially increasing problem. The most efficient solution to solve the global food shortage issue might be the reliance on science

and technology, the growth and consumption of genetically modified (GM) food. Despite many controversies regarding the use of GM food, it could be the best answer to handle this global food shortage (Curtis, 2016).

“The era of GMO deception is history. A food revolution is upon us. And if government will not halt the mass poisoning of our world by evil corporations, I have no doubt that the people will, by themselves, eventually invoke other necessary methods of halting this great evil” (Global Knowledge Center on Crop Biotechnology, n.d.).

The GMO crops that enter the Philippines are corn and feeds for livestock. As such, they eventually end up eaten by Filipinos. The molecular biologist, who also serves as president of the Scientific Council for Independent Research on Genetic Engineering (SCIRGEN), lamented the Philippine government’s move to allow the sale of GMO crops to the public. The government’s lax policy on GMO approvals will inevitably lead to “using Filipino kids as guinea pigs!” Moreover, he noted that the country is the first and only country in Asia to have allowed a GMO food crop to be commercially planted. The Bureau of Plant Industry (BPI), the government agency tasked with regulating GMOs, has also approved 67 additional genetic modifications of plants, or “transformation events” (Monsanto Company, 2015).

Scientific analysis of GMO experimental data reveal evidence of their negative impacts on animal health. For example, a ninety day test on rats conducted by the GMO developers themselves, which shows signs of toxicity in the livers and kidneys of mammals eating commercialized or pre-commercialized GMOs, such as soya, corn or eggplant filled with herbicides or insecticides (National Research Council, 2016). Greenpeace Southeast Asia advocates for sustainable agriculture, lambasted the government’s acceptance of GMO products without demanding proof from the companies that the crops are safe for human consumption (Curtis, 2016). “It is a dangerous and irresponsible policy to allow the environmental releases of GMOs, especially when their long term safety has yet to be scientifically established. Releasing these risky crops into our environment and into our diets could have far reaching and irreversible consequences on human health, ecological integrity and food security” (Thompson, 2016).

In summary, the researcher acknowledges all related studies with their exclusive implications to the present study. It is hoped that this study will play an important contribution to the body of literature in the readiness and also increase the level of awareness of Technology and Livelihood Education students on Genetically Modified Organisms.

3. METHODOLOGY/MATERIALS

The descriptive method of research was used for this study using both descriptive and inferential statistics. The goal of descriptive research is to describe a phenomenon and its characteristics. This research method is more concerned with what rather than how or why something has happened (Nassaji, 2015). Descriptive statistics helps to describe, show or summarize data in a meaningful way such that patterns might emerge from the data.

Inferential statistics on the other hand aims to make generalizations about the population from which the samples are drawn, in this case, through hypothesis testing.

The respondents were mainly the first to fourth-year students of Technology and Livelihood Education enrolled during the 2nd semester of S.Y. 2018-2019. The researcher decided to select 108 samples from the 149 total population of the Technology and Livelihood Education students using the Slovin's Formula.

The researchers used a questionnaire in research to gather the necessary information for the study. It contained questions about the aspects of GMOs. The choices were patterned after the Likert's Scale System: 5-Highly Aware; 4-Slightly Aware; 3-Aware; 2- Slightly Unaware; 1-Unaware. Through this, the researchers were able to find out the level of awareness of the respondents.

To give meaning and interpretation to the data that were gathered, tallied, and tabulated, the researcher made use of weighted mean, a type of average in which weights are assigned to individual values in order to determine the relative importance of each observation.

The weighted mean results of the responses were interpreted with:

Scale	Limits of Description	Verbal Interpretation
5	4.50 – 5.00	Highly Aware
4	3.50 – 4.49	Moderately Aware
3	2.50 – 3.49	Aware
2	1.50 – 2.49	Slightly Aware
1	1.00 – 1.49	Unaware

Analysis of Variance was used to determine the significant difference between and among the level of awareness of the respondents as to Genetically Modified Organisms in terms of Food Products, Plants, Animals, and Medicinal Products. Games-Howell Post Hoc test was used for multiple comparisons.

4. RESULTS AND FINDINGS

4.1. LEVEL OF AWARENESS OF THE RESPONDENTS ON GENETICALLY MODIFIED ORGANISMS IN FOOD PRODUCTS, PLANTS, ANIMALS, AND MEDICINE

4.1.1. Genetically Modified Organisms in Food Products

Table 1. Table1: Level of Awareness of the Respondents on Genetically Modified Organisms in Food Products

Issues/Topics	Mean	Verbal Interpretation
1.1.1. Many varieties of apples we eat today are produced through genetic modification.	1.82	Slightly Aware
1.1.2. GMO has not yet been proven safe for human consumption.	1.73	Slightly Aware
1.1.3. A genetically modified (GM) corn strain approved for food and processing in the Philippines shows signs of toxicity to mammals.	1.81	Slightly Aware

Issues/Topics	Mean	Verbal Interpretation
1.1.4. GM foods can be produced more quickly and there is an additional advantage of GM to food that is grown naturally with the help of genetic enhancement.	1.82	Slightly Aware
1.1.5. The GMO crops that enter the Philippines are corn and feed for livestock.	1.76	Slightly Aware
Overall Mean	1.79	Slightly Aware

Table 1 shows the complete outcome of responses of the respondents on the level of awareness of Technology and Livelihood Education students on Genetically Modified Organisms for food products.

After gathering all the responses, it came out that the respondents have a slight level of awareness on GMOs for food products. The overall mean is 1.79 with the verbal interpretation of "slightly aware". This means that the respondents are not fully knowledgeable about the issues and topics stated above on genetically modified organisms in food products.

4.1.2. Genetically Modified Organisms in Plants

Table 2. Level of Awareness of the Respondents on Genetically Modified Organisms in Plants

Issues/Topics	Mean	Verbal Interpretation
1.2.1. "Scientists and farmers have been genetically modifying plants for hundreds of years."	1.54	Slightly Aware
1.2.2. In the Philippines, 25 GMO food crops (including corn, soybean, sugar, beet, alfalfa, potato, and cotton) have been approved by the BPI for direct use in food, feed, and processing. While four GMO corn crops are approved for propagation, twenty-four of the 29 GMOs are approved in the country.	1.48	Unaware
1.2.3. GM crops are produced more quickly than naturally grown crops. Crop yield will increase significantly which benefits farmers and most importantly, reduce the problem of food shortage.	1.76	Slightly Aware
1.2.4. Greenpeace recently released a report on an independent study showing that the alien genes inserted into GMO crops can cause the plants to cross-breed to related species and become aggressive, problematic weeds that may threaten to overpower similar varieties.	1.00	Unaware
1.2.5. The genetically modified crops – Golden Rice, Bt cotton, Bt eggplant, Bt camote, and Bt abaca are expected to be commercially released soon.	1.06	Unaware
Overall Mean	1.37	Unaware

Table 2 presents the level of awareness of the respondents in terms of genetically modified plants. Data show an overall mean of 1.37 with the verbal interpretation of "unaware". This means that the respondents have not heard or read anything about the issues and topics stated above on genetically modified plants.

4.1.3. Genetically Modified Organisms in Animals

Table 3. Level of Awareness of the Respondents on Genetically Modified Organisms in Animals

Issues/Topics	Mean	Verbal Interpretation
1.3.1. Animals that have had genes artificially added or removed from their DNA are described as genetically modified.	1.03	Unaware
1.3.2. Transgenic animals are spreading commercially	1.04	Unaware
1.3.3. Glofish was the first genetically modified animal to be sold as a pet. A gene from jellyfish, inserted into the Zebrafish genome created the "Glofish" fish that glows in the dark.	1.05	Unaware
1.3.4. The most successful (financially) so far has been a lemur and a cat. It retains the soft fur of the cat and coloring but has the striped tail and yellow eyes commonly found on a lemur. It is more ferocious than the average cat but it is generally no more dangerous than a Chihuahua dog. The scientific name for this new breed is Prolos fira.	1.00	Unaware
1.3.5. Fern spider is unique, as it is the only combined plant and animal. The spider is a cross between a common Italian Wolf spider (<i>Lycosa tarantula</i>) and the ponga fern (<i>Cyathea dealbata</i>)	1.05	Unaware
Overall Mean	1.03	Unaware

Table 3 presents the data of the level of awareness of the respondents on genetically modified animals. The overall mean is 1.37 with the verbal interpretation of "unaware". This means that the respondents have not heard or read anything about the issues and topics stated above on genetically modified animals.

4.1.4. Genetically Modified Organisms in Medicines

Table 4. Level of Awareness of the Respondents on Genetically Modified Organisms in Medicines

Issues/Topics	Mean	Verbal Interpretation
1.4.1. Insulin used in medicine is an example of genetic engineering.	1.05	Unaware
1.4.2. Genetically engineered products include the chemical Aspartame used in sugar-free foods and the drug hepatitis B vaccine.	1.00	Unaware
1.4.3. There is also a genetically engineered hormone, BGH, which is commonly injected into dairy cows in the United States.	1.00	Unaware
1.4.4. In 2009, the US Food and Drug Administration approved the first human drug from a transgenic goat. The drug is an anticoagulant called ATryn extracted from goat milk that reduces the probability of blood clots during surgery or childbirth.	1.00	Unaware
1.4.5. Scientists say GM technology could bring benefits. By creating cattle or other livestock that are resistant to diseases, it could help reduce the use of veterinary drugs in the farming industry. Disease resistance could also help to prevent devastating outbreaks that can threaten a country's entire farming industry, like foot and mouth and bluetongue.	1.00	Unaware
Overall Mean	1.01	Unaware

Table 4 shows the level of awareness of the respondents on genetically modified organisms in medicinal products. The overall mean is 1.01 with the verbal interpretation of "unaware". This means that the respondents have not heard or read anything about the issues and topics stated above on genetically modified organisms in medicinal products.

4.2. LEVEL OF AWARENESS OF THE RESPONDENTS ON HEALTH RISKS OF GENETICALLY MODIFIED ORGANISMS

Table 5. Level of Awareness of the Respondents on Health Risks of Genetically Modified Organisms

Issues/Topics	Mean	Verbal Interpretation
2.1. All genetically engineered crops contain bacterial DNA. The DNA contains a genetic element (the so-called "CpG motif" that stimulates the immune system to start a sequence of reactions leading to inflammation. Exposure to these genetic elements may lead to the promotion of inflammation, arthritis, and lymphoma (a malignant blood disease).	1.03	Unaware
2.2. New study confirms GM food damages fertility	1.03	Unaware
2.3. "GMOs are monsters – they are dangerous to our health, biodiversity, and sustainable farming practices. These 'monsters' have been attacking the Philippines for the past ten years, aided and abetted by the Department of Agriculture."	1.05	Unaware
2.4. GM crops, especially Bt crops, are also associated with health benefits. Direct health advantages for farmers are a result of less insecticide exposure during spraying operations.	1.00	Unaware
2.5. For consumers, Bt crops can yield health benefits through lower pesticide residues in food and water.	1.00	Unaware
Overall Mean	1.02	Unaware

Table 5 shows that respondents are not aware of the health risks of genetically modified organisms. This was described by an overall mean of 1.02 with a verbal interpretation of "unaware."

4.3. SIGNIFICANT DIFFERENCE BETWEEN AND AMONG THE LEVEL OF AWARENESS OF THE RESPONDENTS ON GENETICALLY MODIFIED ORGANISMS IN FOOD PRODUCTS, PLANTS, ANIMALS, AND MEDICINE

Table 6. Analysis of Variance on the Level of Awareness of the Respondents Genetically Modified Organisms in Food Products, Plants, Animals, and Medicine

	Sum of Squares	df	Mean Square	F	Sig.	Decision
Between Groups	1.988	3	0.663	24.293	.000*	Reject Ho
Within Groups	0.436	16	0.027			
Total	2.425	19				

* $p < 0.05$

Table 6 shows that the computed value for F (24.293) and the probability value (.000), which is less than the alpha level (.05), supports the decision to reject the null hypothesis. Therefore, the null hypothesis that there is no significant difference between and among the level of awareness of the respondents on genetically modified organisms in food products, plants, animals, and medicine is rejected at .05 alpha level.

Table 7. Multiple Comparisons on the Level of Awareness of the Respondents Genetically Modified Organisms in Food Products, Plants, Animals, and Medicine

GMO (I)	GMO (J)	Mean Difference (I-J)	Sig.	Decision
Food Products	Plants	.42000	.139	Accept Ho
	Animals	.75400*	.000*	Reject Ho
	Medicine	.77800*	.000*	Reject Ho
Plants	Food Products	-.42000	.139	Accept Ho
	Animals	.33400	.244	Accept Ho
	Medicine	.35800	.208	Accept Ho
Animals	Food Products	-.75400*	.000*	Reject Ho
	Plants	-.33400	.244	Accept Ho
	Medicine	.02400	.357	Accept Ho
Medicine	Food Products	-.77800*	.000*	Reject Ho
	Plants	-.35800	.208	Accept Ho
	Animals	-.02400	.357	Accept Ho

Table 7 presents the multiple comparisons between and among the level of awareness of the respondents on genetically modified organisms in food products, plants, animals, and medicine. It shows that the significant difference is found between their level of awareness of the respondents on GMO in food products and animals, and between food products and medicines.

With the aforementioned findings and conclusions, the researcher would like to recommend the following recommendations since it was found out that there is a great need to raise the level of awareness of the respondents on genetically modified organisms.

1. Not only should the student respondents of the TLE be made aware but also the entire University to make themselves fully aware of the risks/advantages of the genetically modified organisms.
2. The students should be aware of genetically modified foods for them to find out if they are consuming such foods and for them to be able to make the right choices in terms of their food intake.
3. Science Club/Organization should actively support the campaign for the "NO TO GMO" products considering the hazards that these foods can pose to the environment and the health not only of the students but the entire humanity.
4. The faculty and staff of the University should help disseminate the information about genetically modified organisms.
5. Conduct similar studies specifically on related fields of specializations.
6. Considering the preceding recommendations, there is a need to come up with a "UNIVERSITY AWARENESS PROGRAM ON GENETICALLY MODIFIED ORGANISMS". The following have been lined-up to form part of a Continuing Development and Enhancement Program of the University:
 - I. For the College of Teacher Education to spearhead Massive Information Campaign/Drive on GMOs using the following strategies:
 - Provision of Bulletin Boards solely to provide information on GMOs, this must be regularly updated;
 - Preparations of flyers, brochures, information leaflets on GMOs;

- All clubs and organizations of the College of Teacher Education shall be mobilized for the Information Drive.
- II. Monthly symposiums, convocation, seminar-workshops shall be organized by various clubs/organizations to increase the level of awareness of the students.
- III. Focus Group Discussions shall be organized by the department pertinent to cropping issues along with GMOs. These FGDs may come up with presentations of studies, researches, readings gathered that can help raise the level of awareness of the community on GMOs specifically focusing on the effects of GMOs on health and the environment.
- IV. The discussion of the issues on GMOs shall be integrated into subjects that can incorporate the said topics like Science, Agriculture, Food Technology, Values Integration Processes, NSTP classes.
- V. For the Student Teachers Association (STA) to conduct focused programs every semester dedicated to the promotion of scientific findings on GMOs.
- VI. Conduct a similar study in other colleges on GMOs and even include faculty and staff and administrators in the university.
- VII. Create linkages and forge alliances with organizations outside the university just like the Philippine Society of Youth Science Clubbing, Philippine Society of Saving Nature, and other organizations that can be helpful in the quest for the search for reliable information and knowledge on GMO. This includes linking with world organizations using available media and connections.
- VIII. Conduct exposure trips to places where the knowledge of GMOs can be deepened.
- IX. Provide an avenue for the vigilant update of products that are genetically altered and are made available for human consumption.
- X. Come up with a thorough inspection of food available within the university, to determine food and products that are genetically modified to make the university aware of the food they consume.
- XI. Provide an avenue to promote Organically Grown Products as a counter-culture of GMOs, if we are to stop the alterations in the genetic-make-up of God-given plants, animals, and the entire environment.
- XII. Awareness and Promotion of Healthy Lifestyle in the community, to make the population aware of the biological magnifications that can cause toxicity in human bodies.
- XIII. Help promote and strengthen the program of the University on the Integrity of Creation where various programs and projects just like the Material Recovery Facility (MRF) are anchored – this is to promote the use of biodegradables as fertilizers to counter the use of hazardous chemicals/fertilizers being used in the market, that which are causing great damage to farmers' yields. The program also includes Waste Management System, Water and Electricity Conservation Programs, and various programs that are interconnected and interdependent.
- XIV. Organize a Continuing Faculty Development Program on GMOs where respectable icons on GMOs may be invited as resource speakers.

- XV. Come up with a project proposal to support various programs especially along with the protection of the environment and the promotion of a healthy lifestyle not only for the benefit of the students but also of the entire community.

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