

INVESTIGATING THE HIGH SCHOOL STUDENTS' UNDERSTANDING AND INSIGHT ON BIOTECHNOLOGY

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ABSTRACT

The purpose of this study is to examine the level of awareness of 10th to 12th class students in regard to the science of biotechnology. Biotechnology generally includes a set of technologies that use living or biological organisms such as plants, animals and microorganisms to produce new products. The statistical population of this research includes male and female high school students of Herat Province, among whom 220 students were randomly selected. Data collection tools and research questioners with indicators on understanding of biotechnology and its usage was set. After determining the validity and reliability of the questionnaires using experts' opinion and coefficient Cronbach's alpha, the questionnaires were completed by the target group. The results of this research showed that students have relatively less understanding of the science of biotechnology, but showed a higher understanding in relation to the usage of this science. According to the results, teaching the basic concepts of this science is necessary to help students to understand and obtain information about this science.

Keywords: high school students, biotechnology knowledge, biotechnology applications

INTRODUCTION

In the 19th century, with the invention of the optical microscope by the Dutch scientist Anthony Phillips van Livon Hook biological sciences entered a new era called cellular and molecular biology. These sciences due to their wide range of expansion are divided into the following sub-sets of biochemistry, microbiology, cell sciences Molecular, genetic and biotechnology. The science of biotechnology is a set of activities that includes

biological and biochemical processes to achieve the industrial use of microorganisms, cultured cells of various tissues and related matters. The above definition about this science differs in different countries around the world. In addition to the above definition, the term biotechnology was used for the first time in 1919 by Crowley Arki, meaning "the application of biological sciences and their interaction in man-made technologies." The main body and structure of this science is a set of sciences such as biology, chemistry and engineering processes.

Biotechnology is one of the sciences that has developed rapidly in the 21st century and is considered a vital development in the scientific and economic fields. We have witnessed various measures in various fields such as agriculture, genetic modification of plant species, the creation of new species, as well as identifying people vulnerable to certain diseases in the field of medicine.

Among the traditional usage of biotechnology, we can mention the production of various pickles, the gradual formation of lactic acid in sourdough in the preparation of bread, and breeding of plants and animals. With the progress of this science, today it is possible to create recombinant vaccines, monoclonal antibodies, diagnosis and treatment of diseases such as cancer and AIDS, gene therapy, etc. in the field of medicine. Today, due to the rapid development of biotechnology, the importance, necessity and various usage of this science such as the medical industry, pharmaceuticals, nutrition, agriculture and the environment, as well as genetic engineering methods such as cell culture techniques, the education of this Science and ethical issues related to it and its inclusion in the curriculum framework are necessary for students in society and around the world.

The purpose of this research is to examine the level of knowledge and understanding of 10th to 12th class students in relation to the familiarity and usage of biotechnology.

RESEARCH METHOD:

The method of this research is descriptive which deals with content analysis. Descriptive research deals with describing and analyzing the obtained information.

Society and statistical sample of the research:

In this study, 220 questionnaires were filled by high school students including of girls and boys from high schools, located in the Herat Province. The size of the statistical population was selected according to the previous research conducted in this field, among which thirty-two percent of the respondents were male and sixty-eight percent of them were female. Due to the tendency of girls to study experimental sciences, a significant



portion of the questionnaires was allocated to girls in this research.

In the collected questionnaires of this research, sentences related to the understanding of biotechnology and its usage in the fields of health and medicine as well as agriculture and food production were collected of high school students between the classes of 10th to 12th. The questionnaires were filled by the students of the statistical population and the relevant data were analyzed by Excel software.

Questions related to the perception of biotechnology:

The level of complexity of the questions was well chosen, and few questions were not answered. The validity and reliability of the questions of this research were evaluated by experts and Cronbach's alpha coefficient, and according to this coefficient, they were at its ideal level.

- Biotechnology interferes with nature.
- Biotechnology is the genetic manipulation of living organisms, which benefits humans.
- Genetically modified crops only benefit people living in the third world.
- The cloning of humans causes the creation of a completely identical generation (physically and in terms of personality).
- If a person consumes genetically modified products, it can be concluded that her genes have changed.
- More than half of human genes are similar to chimpanzees.
- Criminal tendencies are mainly inherited genetically.
- It is impossible to transfer animal genes to plants.

Questions related to the usage of biotechnology in different fields:

The level of complexity of the questions was chosen at a good level and few questions had no answers. The validity and reliability of the questions of this research were evaluated using the opinion of experts and Cronbach's alpha coefficient, and according to this coefficient, they were at the ideal level.

- Biotechnology helps human health, such as the treatment of many genetic diseases.
- Biotechnology enables humans to replicate themselves.
- Biotechnology is only related to modified crops such as canola or rice.
- New medicines that are useful for human health are produced every year using biotechnology.
- Biotechnology has an important impact on the prevention, diagnosis and treatment of human cancers

- The genetically modified animals and plants used in human food has an important effect on their health.
- Genetically modified products (tomatoes, wheat, etc.) have genes, while normal products do not have genes.
- Bacteria are effective in the production of food such as pickles and mushrooms.

RESULTS:

In this study, two questionnaires were completed by 220 high school students between the 10th and 12th classes, among which thirty-two percent of the respondents were boys and sixty-eight percent of them were girls. In order to attract more high school girls to the field of experimental sciences, a significant portion of the questionnaires was dedicated to girls in this research. The answers related to the questions on understanding and having knowledge of biotechnology are shown in Table No. 1 in terms of percentage.

NO	Questions	Agree	Disagree	Neutral	Total
Q1	-Biotechnology interferes with nature.	37%	19%	44%	100%
Q2	-Biotechnology is the genetic manipulation of living organisms, which benefits humans.	26%	31%	43%	100%
Q3	-Genetically modified crops only benefit people living in the third world.	29%	43%	28%	100%
Q4	-The cloning of humans causes the creation of a completely identical generation (physically and in terms of intelligence).	26%	44%	30%	100%
Q5	-If a person consumes genetically modified products, it can be concluded that her genes have changed.	37%	39%	24%	100%
Q6	- More than half of human genes are similar to chimpanzees.	46%	20%	34%	100%
Q7	- Criminal tendencies are mainly inherited genetically.	37%	39%	24%	100%
Q8	- It is impossible to transfer animal genes to plants.	30%	25%	45%	100%

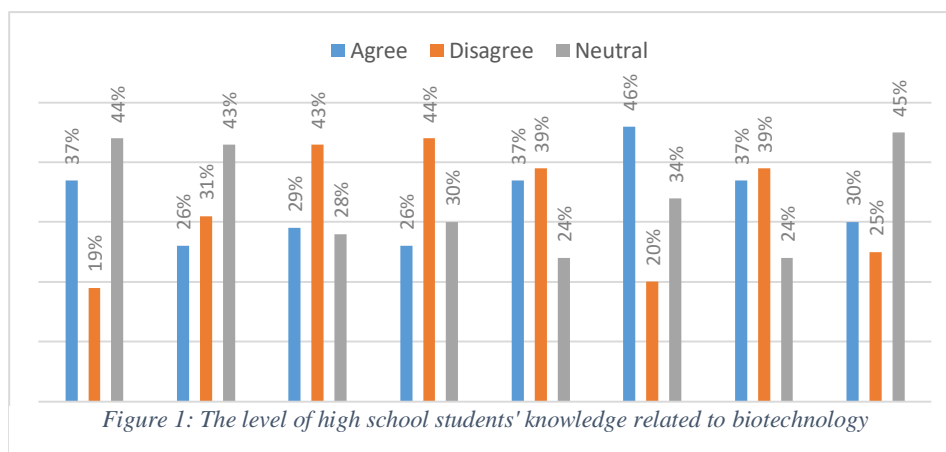


Table 1: The level of high school students' knowledge related to biotechnology

As it is clear in Table 1 and Chart 1, the highest number of students agreed upon is related to the second and sixth sentences respectively, which accounts for approximately 50% (above 40) of the frequency. As it is clear in the diagram, in response to the most of the questions, the students mostly had opposite opinion or had no opinion. The highest percentage of students disagreed with the third and fourth sentences of the

questionnaire with a rate of over 40% which shows that students' awareness and understanding of biotechnology is relatively low. Also, the high percentage of students' answering the second questionnaire and answers related to questions on different usage of biotechnology are shown in table no. 2 and bar graph no. 2.

NO	Questions	Agree	Disagree	Neutral	Total
Q1	- Biotechnology helps human health, such as the treatment of many genetic diseases.	56%	23%	21%	100%
Q2	- Biotechnology enables humans to replicate themselves.	42%	30%	28%	100%
Q3	- Biotechnology is only related to modified crops such as canola or rice.	44%	38%	18%	100%
Q4	- New medicines that are useful for human health are produced every year using biotechnology.	52%	23%	25%	100%
Q5	- Biotechnology has an important impact on the prevention, diagnosis and treatment of human cancers	37%	34%	29%	100%
Q6	- The genetically modified animals and plants used in human food has an important effect on their health	37%	34%	29%	100%
Q7	- Genetically modified products (tomatoes, wheat, etc.) have genes, while normal products do not have	42%	31%	27%	100%
Q8	- Bacteria are effective in the production of food such as pickles and mushrooms.	54%	28%	18%	100%

Table 2: -High school Students' responses on questions related different usage

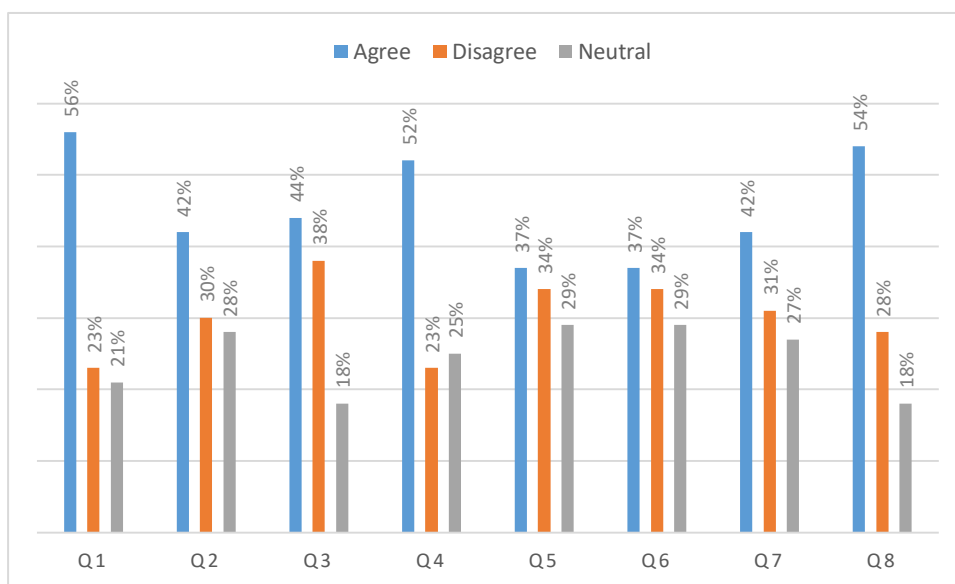


Figure 2: High school students' responses on questions related different usage of biotechnology

of biotechnology

According to the above table and diagram, the students agreed upon and answered most of the questions. In seven of the questions, the percentage of students with positive response was higher than 40%, and only in response to one question the percentage was lower than 40%. These results have shown more development compared to the results of Table 1 and Chart 1 and indicate that students have more knowledge about the usage of biotechnology than having awareness of the science of biotechnology.

For a more detailed study, we separated the questions in Table 2 and Figure 2 on the usage of biotechnology in two areas: 1. health and medicine and 2. Agriculture and food production, which are shown separately in figure 3 and 4. Questions 1, 2, 4, and 5 are



related to health and medicine, and questions 3, 6, 7, and 8 are related to agriculture and food.

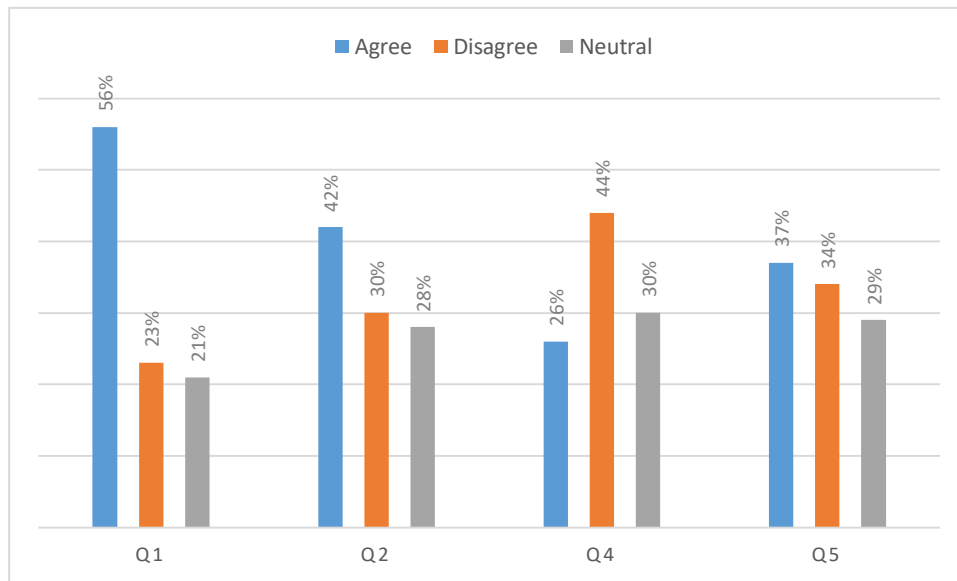


Figure 3: High school students' perception regarding to questions related Health and medicines

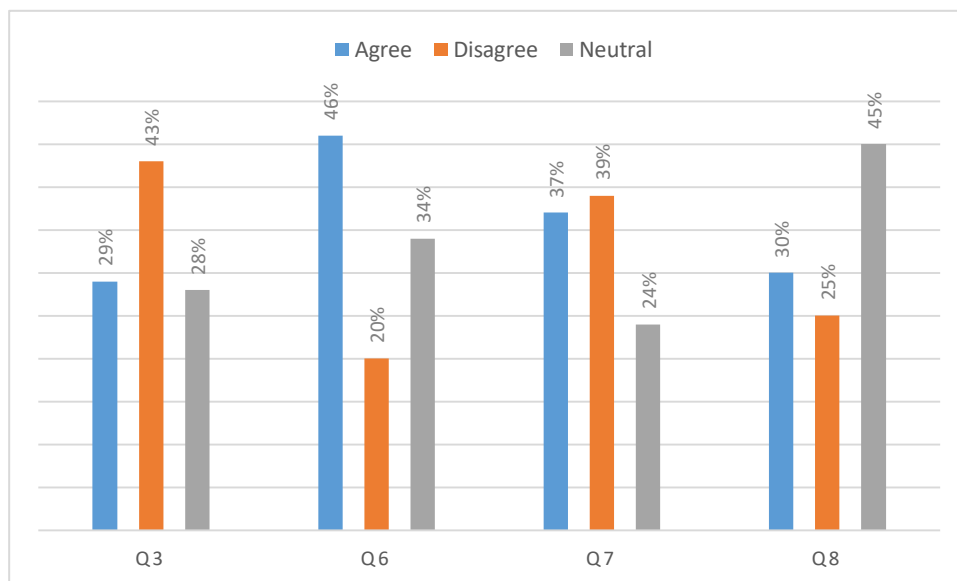


Figure 4: High school students' perception regarding to questions related agriculture and food

Comparison of graphs 3 and 4 shows that students are more aware of the usage of biotechnology in the field of health and medicine than of agriculture and food production. More than 50% of the students agreed with 3 questions related to health and medicine, and more than 50% of the students agreed on only one of the questions related to agriculture and food production.

CONCLUSION

The results of this study show that a significant percentage of students have sufficient information and have chosen the option I agree in relation to the usage of biotechnology. But in relation to understanding the basic concepts of this science, they had relatively less understanding and need more knowledge.

In a study conducted by colleagues in 2005, 84 students between the ages 15 to 18 expressed their opinions regarding the knowledge of biotechnology and its usage. In the meantime, a significant percentage of students were aware of the effect of yeasts and microorganisms in food. Also, regarding the usage of biotechnology, seventy-four percent of the students agreed with the above sentence (biotechnology is the genetic manipulation of living organisms, which is beneficial to humans). Also, in connection with the information sources of biotechnology, the students of the universities have been listed as an important source of information.

Also, in a research conducted in the United States in 2010 by Chabalengola colleagues, the knowledge of eighty-eight teachers in relation to the understanding of biotechnology and its related processes was examined. In this research, teachers were asked to provide definitions and examples related to cloning, biotechnology and genetic engineering. In general, many teachers had information about cloning, but could not provide an acceptable definition in relation to the correct definition of biotechnology.

According to the results of this research, it seems necessary to teach the basic concepts of this science to students, especially high school students.

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