

Biological enlightenment among students of the College of Education for Pure Sciences and their relationship to sustainable development

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ABSTRACT

The research aims to identify the biological enlightenment among students of the College of Education for Pure Sciences and their relationship to sustainable development. To achieve the research objective, the descriptive approach was adopted, by reviewing the literature and previous studies related to the research, the research tools were built, the first research tool was the biological enlightenment scale, which included (49) paragraphs distributed over (5) fields, and the second tool was the sustainable development dimensions scale, which included (50) paragraphs, and presented to arbitrators and experts. The validity of the two research tools was verified and the two research tools were applied to a sample of 150 students in the Department of Life Sciences at the College of Education for Pure Sciences. Statistical methods were used (T-test equation, Chi-square equation, Pearson correlation coefficient, Sperman-Brown coefficient, hypothetical mean equation) and the results showed.

1-The level of biological enlightenment and the level of sustainable development among third-stage students came at a higher level compared to the hypothetical mean.

2-There is no correlation between biological enlightenment and sustainable development.

KEYWORDS: Biological enlightenment, students of the College of Education for Pure Sciences, sustainable development.

INTRODUCTION

The rapid scientific and technological progress in various areas of life raises issues of interest to people in all societies, and to the extent that it contributes to solving the problems of the individual and society and the resulting benefits for humans, and increases their ability to benefit from environmental resources, and control them, to the extent that it results in harms and risks that threaten human life.

This era is witnessing a race between advanced countries in the fields of atomic research and space exploration, biotechnology, genetic engineering technology, cloning technology, gene therapy technology, human reproduction technology, birth control technology, and human organ transplantation and manufacturing technology. This requires striving to spread science and simplify it so that individuals become able to face life in a manner that is consistent with the age of science. Anyone who looks at current curricula and the different stages of education finds a weak connection between science on the one hand, technology on the other hand, and society on the third hand, whether in curriculum design or in the content of the study or its implementation through teaching methods. The teacher is still far from noticing the relationship of overlap and interconnection between these three elements, as sciences are not separated from the issues, problems, and aspirations of society, as curricula and study content. Here, students of the College of Education for Pure Sciences face some problems in possessing biological enlightenment and sustainable development, so it was necessary to know the extent of their possession of this enlightenment, and this study will work to know the biological enlightenment of students of the College of Education for Pure Sciences and its relationship to their sustainable development.

By reviewing the curricula of the college and students of the College of Education for Pure Sciences and reviewing many previous studies, the requirements of biological enlightenment must be taken into account

and biological issues with social and ethical aspects must be discussed, especially issues related to biotechnological applications in the field of food production, medicine, treatment, and human reproduction. What is biological enlightenment among students of the College of Education for Pure Sciences and its relationship to sustainable development?

IMPORTANCE OF THE RESEARCH

The modern era has witnessed a scientific revolution that has brought about rapid change and development in scientific and technological knowledge. Societies have transformed from knowledge to beyond knowledge, from communications to the communications revolution, from genetic engineering to genetic mapping and gene therapy, and from biochemistry to biotechnology. After the progress of any society was measured by its strength and industrial renaissance, its progress has become measured by its intellectual, scientific and cultural strength, which has helped this development to be reflected in the quality of life that humans live, such that it has imposed on the human being of this era to be characterized by scientific qualities and possess diverse abilities and skills to understand what is going on in the world around him, as he lives in this era, the era of science, where science and its applications have become necessities of life and the state that holds the reins of science and technology is undoubtedly the strongest state. This era is also witnessing a race between advanced countries in the fields of atomic research, space exploration, biotechnology, and genetic engineering, which requires striving to spread science and simplify it so that individuals become able to face life in a manner that is consistent with the age of science. (Saleem, 1: 1989)

Here comes the role of education, as it is one of the basic pillars that enables the individual to follow scientific developments and the local and global issues that result from them. Therefore, it must work to prepare a generation armed with the greatest amount of knowledge and skills to face life and practice its role positively in serving society. The largest part of this task falls on scientific education in the various stages of education. In addition, the rapid scientific and technological progress in various areas of life raises ethical issues and problems that interest people in all societies. To the extent that science and technology contribute to solving the problems of the individual and society, and the resulting benefits for humans, and the increase in their ability to benefit from environmental resources, and control things, to the extent that it results in harms and risks that threaten human life, and raises new controversial issues revolving around what is right and what is wrong, what is acceptable and what is rejected, and what is good and what is evil (Abdul Salam, 2001: 332). Accordingly, there is an urgent need for scientific education that helps to form a critical, questioning mentality among individuals that uses the scientific method of thinking without being bound by superstitions. (Saleem and Nader, 1972: 63) The objectives related to preparing a scientifically enlightened citizen are considered among the most important objectives of science education at the present time. This importance was confirmed by the federal committee responsible for developing science education in the United States of America, where it defined the objective of science education as preparing a scientifically enlightened citizen. To Prepare Scientifically Literate Individual, the continuous increase in scientific knowledge, as Saber Saleem confirms, "imposes on the person of this era a scientific enlightenment that keeps pace with this increasing knowledge and helps him understand what is going on around him. In order for a person to keep pace with his era, he has no choice but to seek to follow up and acquire that knowledge, methods of thinking and scientific trends and to employ them in his daily life, in other words, to be scientifically enlightened." (Saleem, 1989: 2) Sustainable development is considered a link between the current generation and the next generation that ensures the continuity of human life, and guarantees the next generation a decent living and a fair distribution of resources within a single country, and even between multiple countries. The importance of sustainable development lies in its being a means of bridging the gap between developed and developing countries and plays a major role in reducing economic dependence on the outside, distributing production, protecting the environment, social justice, improving the standard of living, raising the level of education, reducing the illiteracy rate, providing capital, raising the level of national income, and social justice.

To narrow this gap and achieve all these priorities, we must have a well-thought-out and clear strategic vision to be able to leave a legacy for the next generation. Sustainable development is also a link between the North and the South, an integration of interests between them, and a repayment of the debt of developed countries

that depleted the resources of different countries during colonialism. (Abu Al-Nasr, Madhat, et al., 2017, pp. 84-92)

Third: Research objectives and hypotheses:

The current research aims to identify:

- The level of biological enlightenment among students of the Faculty of Education for Pure Sciences / Department of Life Sciences / third stage.

Are there statistically significant differences at a significance level of (0.05) between the average scores of biological enlightenment among students of the Faculty of Education for Pure Sciences / Department of Life Sciences / third stage and the hypothetical mean in the biological enlightenment scale.

- The level of sustainable development among students of the Faculty of Education for Pure Sciences / Department of Life Sciences / third stage.

Are there statistically significant differences at a significance level of (0.05) between the average scores of sustainable development among students of the College of Education for Pure Sciences / Department of Life Sciences / Second Stage and the hypothetical mean in the Sustainable Development Scale.

- The relationship between biological enlightenment and sustainable development.

Is there a statistically significant correlation at a significance level of (0.05) between biological enlightenment and sustainable development among students of the College of Education for Pure Sciences / Department of Life Sciences / Third Stage?

Fourth: Research Limits:

The research will be limited to the following limits:

- 1- Human limit: Third-stage students in the College of Education for Pure Sciences at Al-Muthanna University.
- 2- Temporal limit: Academic year (2022-2023 AD).
- 3- Spatial limit: Al-Muthanna University.
- 4- Cognitive limit: Biological enlightenment, sustainable development.

Fifth: Research terms:

1- (Biological enlightenment)

It was defined by: Fouda (2010) as “the minimum level of biological knowledge and skills that the learner must possess to use in daily life in understanding and interpreting phenomena and many advanced biological issues and problems and making sound decisions regarding them.” (Fouda, Hiba Muhammad, 2010: 9)

Lulu (2017) “Acquaintance with an appropriate amount of biological knowledge that the student must possess to use in his daily life in understanding and interpreting advanced biological phenomena and the problems they raise in the fields of health, population, environment, nutrition, and genetics, with knowledge of the bioethical and social issues that result from the rapid development of biological knowledge, and the ability to make sound decisions, and is measured by the total score that the student obtains on the biological enlightenment test prepared in this study.” (Lulu, Fathia, 2017: 12)

Procedural definition:

The level of the student’s possession of an appropriate amount of biological knowledge and skills that the learner must possess to use in daily life in understanding and interpreting phenomena and many advanced biological issues and problems and making sound decisions towards them, and is measured by the score that the student obtains on the biological enlightenment test prepared for that. 1- Sustainable development

It was defined by:

The Ministry of Environment “It is the right of the present generation to use natural resources to improve human life and secure its needs in a way that preserves the sustainability of these resources in a way that preserves the environment and provides the ability for future generations to secure their needs as well. Or it is development based on integrating economic development, environmental protection, and social affairs within

a single framework.” (Ministry of Environment, Sustainable Development Department)

Al-Hassan (2009) "It is a series of quantitative and qualitative variables among a specific group of people that will lead over time to an increase in the standard of living and a change in lifestyle. (Al-Hassan, 2009: 7)

Procedural definition:

Achieving a balance between different and sometimes conflicting needs on the one hand, and awareness of the environmental, societal and economic limitations that we face as a society on the other hand, i.e. focusing on the future. This does not necessarily mean harming the right of the current generation to a better life, i.e. one that is beneficial in the short and medium term for current generations and beneficial in the long term for future generations. And meeting the needs of society at the present time by optimally using available resources without wasting the right of future generations to benefit from these resources, and includes three main aspects of development: economic, environmental and social.

Theoretical background

First axis: Biological enlightenment

Biological enlightenment is part of scientific enlightenment, as it has become necessary to pay attention to educating the individual biologically, especially since we live in the era of the scientific revolution, in addition to the fact that biology deals with many necessary topics related to health, nutritional, sexual, environmental, genetic and cultural culture related to the human being himself.

The concept of biological culture can be viewed through the concept of scientific culture itself as a result of physical or chemical culture, biology and the environment. (Zidan, et al., 2004: 192)

Al-Wasimi (2003: 216) defines biological culture as: "Providing the learner with biological information and knowledge related to his needs and environment, appropriate trends towards biological issues and problems, and various skills necessary to restore life as a citizen capable of solving the problems he faces and dealing with daily life situations, keeping pace with biological innovations and making appropriate decisions about them." Alian (2008: 61) defines it as: “possessing the minimum level of knowledge and information related to biology that helps him live with dignity and awareness in light of the rapid scientific developments on the local and global levels.”

The relationship between biological culture and biological enlightenment:

Scientific culture is the scientific knowledge, trends and skills that an individual needs to qualify him to live his world and his present daily life and to influence it in an effective and fruitful way for him and the society in which he lives.

A scientifically educated person is “a person who is aware of the mutual influences between science, technology and society, and uses this knowledge in making his daily decisions related to them. A scientifically educated individual possesses a solid knowledge base of facts, concepts, conceptual networks and procedural skills that qualify him to continue learning and thinking logically. He also appreciates the value of science and technology in developing societies and improving people’s lives, with the necessity of being aware of their limitations and risks to societies at times.” (National Science Teacher Association 1982) Quoted from Ru’ya Educational Magazine, Issues 11 and 12)

Abu Fouda (2010:62) believes that “there is a difference in degree between these two concepts and not a difference in type. The concept of culture is deeper, broader and more comprehensive than the concept of enlightenment, and enlightenment represents a stage prior to culture. Despite this, many researchers confuse these two terms and use them as if they mean the same thing, especially since they are a translation of one term, which is (Literacy).

Levels of Biological Enlightenment:

He presented The Biological Science Curriculum Study (BSCS) guide to developing biological literacy (1993) has four graded levels of biological literacy. The ultimate goal of studying biology programs is for the individual to reach the highest level of biological literacy, and these levels are: (BSCS 1993, 19)

1- Nominal Biological Literacy:

At this level, the individual can give a definition of biological terms and concepts, but he has a wrong understanding of some concepts and gives naive explanations for biological phenomena, meaning that this literacy is only nominal.

2- Functional Biological Literacy:

At this level, the individual has familiarity with biological concepts and terms and gives them correct definitions, but he often memorizes them without a good understanding of their meaning. This may be due to the fact that curricula and teachers focus on acquiring biological concepts and terms that are measured by exams.

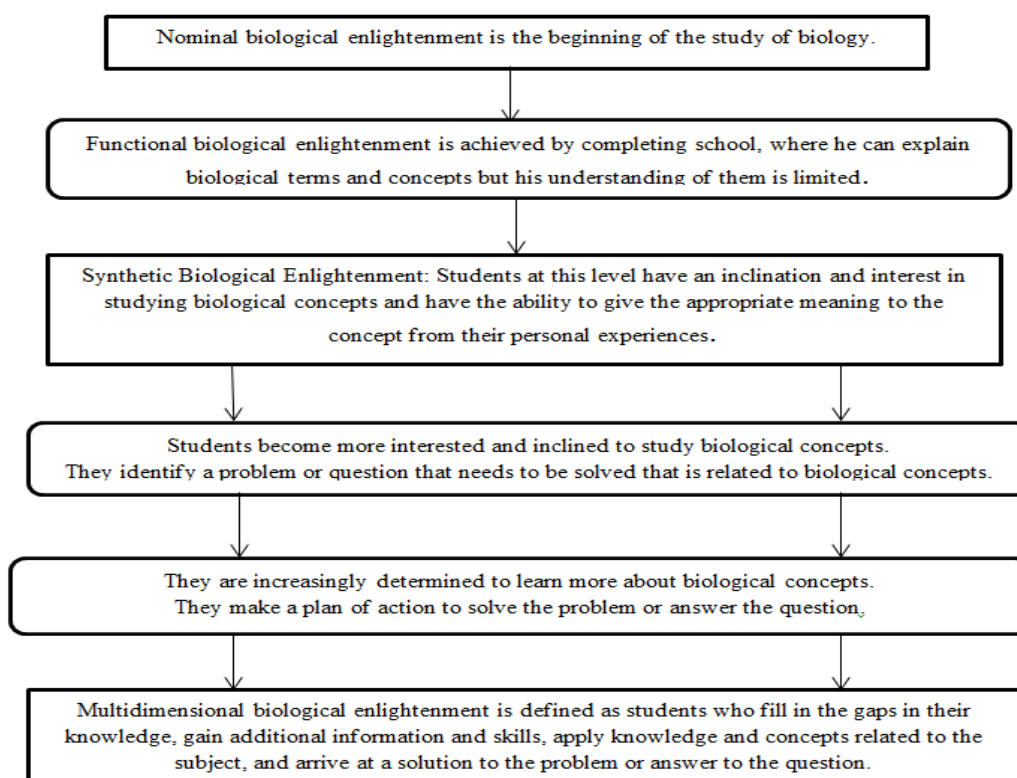
3- Structure Biological Literacy

The individual at this level has a conceptual framework for biology that is linked to the unified principles of biology and uses investigation processes and scientific thinking processes in the field of biology and can apply what he has learned in life situations.

4- Multidimensional B.L.

The individual at this level understands the connection between biology and other sciences, as well as the history and nature of biology and the interactions between biology and society. Figure (1) illustrates the multi-stage biological enlightenment as presented by the BSCS project

Figure (1) the multi-stage biological enlightenment as presented by the BSCS project



Elements of biological enlightenment:

The elements of biological enlightenment can be identified by reviewing some previous research and studies

that dealt with these elements or components, which are as follows:

Al-Wasimi (2003:220) identifies the elements of biological enlightenment as follows:

-Biological knowledge:

It includes facts, concepts, generalizations, principles and laws.

- Skills related to biology:

They include scientific thinking skills that help the individual solve the problems he faces in his daily life, the scientific thinking skill that helps the individual solve the problems he faces in his daily life, and the critical thinking skill that helps him acquire the ability to issue sound logical judgments on biological issues, topics and innovations, which leads to his acceptance or rejection of the opinions put forward regarding them, and other skills such as manual and social skills related to biology.

- Biology-related trends:

Includes the scientific trends that the individual is desired to acquire, such as accuracy, objectivity according to the survey, scientific integrity, and deliberation in issuing judgments, etc., in addition to positive trends towards biological topics, issues, and innovations, and towards biologists.

As for Alian (2008:66), he identified the following elements of biological enlightenment:

- ✓ Understanding the basic concepts of biology, especially those related to biological innovations.
- ✓ Understanding the nature of biological knowledge
- ✓ Understanding the relationship of biology to the development of living organisms.
- ✓ Using the scientific thinking method in the field of biology.
- ✓ While the DBL Biological Enlightenment Development Project identified the elements of biological enlightenment in the following points:
- ✓ Familiarity with the conceptual framework of biology, which includes the unified principles of biology and the basic concepts associated with them.
- ✓ Understanding the relationship between biology and other sciences
- ✓ Understanding the relationship between biology, biotechnology, and society.

Sustainable Development

The concept of sustainable development (SD / Sustainability)

Sustainable Development was first defined in (1987 AD) in the report of the World Commission on Environment and Development - entitled "Our Common Future" - as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs, and the German Council for Sustainable Development (Rat für Nachhaltige Entwicklung) links it to what is known as future-oriented management, which means that we must leave sound environmental, social and economic systems for future generations, as one cannot be achieved without the other. Sustainable development expresses development that is characterized by stability, possesses factors of continuity and communication (Qasim, 2010: 20), and works to meet current needs while contributing to the needs of future generations.

Gilbert et al (1990, Gilbert et al) believe that there are three basic components of sustainability, which are:

- Environmental sustainability: which requires that natural capital remains Sound. This means that the tasks of the environment's resources and its ability to absorb waste should not be reduced, and therefore, the extraction of renewable resources should not exceed their rate of renewal, and the environment's absorptive capacity to absorb waste should not be exceeded, and the extraction of non-renewable resources should be reduced and should not exceed the agreed minimum strategic levels.
- Social sustainability: which requires maintaining the cohesion of society and its ability to work towards achieving common goals, and individual needs should be met, such as those related to health and well-being, nutrition, shelter, education, and cultural expression.
- Economic sustainability: which occurs when growth that moves towards social and environmental sustainability is financially feasible. From the perspective of the United Nations represented by UNESCO, sustainable development is a concept with three interconnected dimensions, including society, environment,

and economy, in addition to culture, which is an implicit dimension that links these dimensions, and the political aspects fall under the dimension of society.

The basic concepts associated with sustainable development from an Islamic perspective include the following: -

- 1) Wisdom: It represents the purposeful pursuit of wisdom, and the search for it from all nations. This cross-fertilization of knowledge is a crucial element in transforming societies into ecological societies based on values that embrace sustainability as a way of life.
- 2) Justice: It means good governance in its broadest sense, which is the fundamental essence of a sustainable rule based on rights.
- 3) Interest: This concept refers to the consensus of the community on all. This represents a rule and principle for defining collective goods or public interests.
- 4) Diligence: It refers to the application of diligence and intellectual capital to solve current and emerging problems. It also relates to reinventing new tools and methods for the transition to sustainable development.

Foundations of sustainable development:

- 1- Development should take into account the preservation of the characteristics and level of current and future performance of natural resources as a basis for the partnership of future generations in the available resources.
- 2- Development in this concept is not based on the value of the returns of economic growth as much as it is based on the quality and manner of distributing those returns, and the resulting improvement in the living conditions of citizens when linking development policies with environmental conservation.
- 3- In harmony with the environment, it aims to reduce the manifestations of harm and disruption of the environmental balance and to preserve the continuity of natural resources.
- 4- It is not enough to modify investment patterns and production structures, but it is also necessary to modify the prevailing consumption patterns to avoid extravagance, waste of resources and environmental pollution.
- 5- Sustainability, continuity and continuity of production systems are the basis for preventing the possibility of the collapse of the components of development, especially in developing countries that rely on traditional systems linked to the components of the natural environment.

Sustainable development goals:

1. Eradicate poverty and hunger in all its forms everywhere
2. Eradicate hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Ensure healthy lives and well-being for all at all ages
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls.
6. Ensure the availability and sustainable management of water and sanitation services for all.
7. Ensure affordable, reliable and sustainable access to modern energy services for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10. Reduce inequality within and among countries
11. Make cities and human settlements inclusive, safe, resilient and sustainable
12. Ensure sustainable consumption and production patterns
13. Take urgent action to address climate change and its impact
14. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels
15. Strengthen the means of implementation and revitalize the global partnership for sustainable development financial affairs.

Dimensions of achieving sustainable development

Sustainable development has integrated dimensions for its success, including the economic, social, political, environmental, and technical dimensions. The following is a presentation of these dimensions

The economic dimension:

- 1) This dimension includes the necessity of properly re-reforming the economy in society to achieve the best standard of living for its members and increasing the individual's share of real national income.
- 2) This also includes stopping the waste of natural resources, whether by making continuous reductions in the levels of wasteful energy consumption by improving the level of efficiency and making a radical change in the lifestyle or changing consumption patterns that threaten biodiversity in other countries without the need for developed countries to consume endangered animal products.
- 3) In addition to considering sustainable development as economic opportunities, by identifying the types of capital, whether natural, human, or social, and working to provide future generations with an amount of capital at least equal to what is available to the current generation.
- 4) The economic dimension is also characterized by working to reduce the economic dependence of developing countries on rich countries, while depriving the resources of poor communities for the purposes of continuous improvement in living standards, ensuring that there is no income disparity, alleviating the burden of poverty, and making opportunities for access to resources, products, and services among individuals within society closer to equality.

Social/Human Dimension:

- 1) This dimension includes that sustainable development takes into account human happiness by improving the quality of life, providing job opportunities, and the prevalence of values of justice and equality among the population, with a general focus on deprived or marginalized groups. In addition, there is the need to focus on directing efforts to invest in human capital, especially in developing countries, where investment in health, education, and nutrition is required, and increasing people's knowledge and skills to help them improve their performance in work and production.
- 2) This dimension also includes working to achieve significant progress in stabilizing population growth so that the increase does not limit development efforts, in addition to paying attention to distributing the population by establishing new cities and promoting active rural development to slow down the movement of migration to cities, and adopting technologies that lead to reducing to a minimum the environmental impacts of urbanization. The social dimension also includes fully utilizing human resources by fighting hunger, improving the level of services, and reallocating resources to ensure the fulfillment of basic human needs and protecting cultural diversity.
- 3) Finally, paying attention to achieving social justice among individuals and societies and not sacrificing future generations in ways to satisfy the needs and confront the problems of the current generation.

Environmental dimension:

- 1) This dimension means that sustainable development is concerned with achieving an environmental balance between human efforts and activities and the environment, and supports positive efforts and overcoming the negative ones that cause an imbalance in the environmental balance and preventing human depletion of environmental resources, so that doing so does not affect the future of development in society. This dimension also means caring about protecting, maintaining and developing the natural resources necessary for the production of food and supplies, and taking measures to prevent soil damage or the destruction of the vegetation cover and developing and adopting improved agricultural practices and technologies that increase production.
- 2) Water conservation, especially in areas where water supplies are scarce, in addition to protecting the climate from global warming and not risking making major changes in the global environment that would cause a change in the opportunities available to future generations. This means preventing the destabilization of the climate or physical and biological geographic systems or the destruction of the ozone layer that protects the Earth as a result of human actions.
- 3) The necessity of paying attention to estimating the environmental impacts

in all basic development projects in society, while reducing waste by reusing resources, which reduces damage and increases the contribution of reused resources in production and consumption, and paying attention to achieving and increasing environmental awareness in a way that ensures local participation of all residents of society in preserving the environment and not harming it.

Characteristics of sustainable development:

- It differs from development in general in that it is more intrusive and more complex, especially with regard to what is natural and what is social in development, in addition to having a spiritual and cultural dimension linked to maintaining the civilizational privacy of societies.
- It is primarily directed to meeting the requirements and needs of the poorest segments of society and seeks to reduce the exacerbation of poverty in the world by achieving a balance between the environmental, economic and social system and achieving social welfare.
- Its elements cannot be separated and its indicators measured due to the overlap of the quantitative and qualitative dimensions it includes.
- It is based on the idea of justice between individuals, between generations and between peoples, in addition to paying attention to the role of civil society and its organizations and all segments of society, especially women and children, in development activities, which contributes to raising the standard of living of members of society.
- It cares about resources, whether human, environmental or societal, and works hard through its activities to raise awareness of preserving and investing in them, especially in their connection to human development, as the continuation of development depends on human decisions. Therefore, working to empower, educate and organize people is its first work.
- It considers the time dimension to be a fundamental dimension, as it is a long-term development that depends on estimating the potential of the present, taking into account the right of future generations to available or potentially available societal resources, in addition to its reliance on coordination and integration between resource uses, investment trends and institutional.

The importance of sustainable development:

Sustainable development is a link between the current generation and the next generation that ensures the continuity of human life, and guarantees the next generation a decent living and fair distribution of resources within a single country, and even between multiple countries.

The importance of sustainable development lies in being a means of bridging the gap between developed and developing countries and plays a major role in reducing economic dependence on the outside, distributing production and protecting the environment, social justice, improving the standard of living, raising the level of education, reducing the illiteracy rate, providing capital, raising the level of national income, and social justice.

To narrow this gap and achieve all these priorities, we must have a well-thought-out and clear strategic vision to be able to leave a legacy for the next generation. Sustainable development is also a link between the North and the South, an integration of interests between them, and a repayment of the debt of developed countries that drained the resources of underdeveloped countries during colonialism.

Research Methodology and Procedures

This chapter includes the research methodology and procedures followed by the researchers to achieve the research objective, which aims to know the biological enlightenment and its relationship to sustainable development among students of the College of Health and Medical Technologies. The researchers followed the descriptive approach, in line with the nature of the research.

First: Research Community

The research community is represented by all students of the College of Education for Pure Sciences / in the center of Muthanna Governorate for the academic year 2023/2022. In order to determine the two research samples from the original community that the researchers identified to conduct their study on, the researchers

conducted the study on university students at Muthanna University.

Second: Research Sample

The sample is that part of its collective individuals from which the researcher derived her information (Al-Qawasmeh and others, 2012: 203).

A- College sample

After the researchers visited the College of Education for Pure Sciences at Al-Muthanna University and obtained a list of the departments available in the college in the center of Al-Muthanna Governorate, a sample was chosen randomly from the research community, which numbered ((2 scientific departments, if 1)) departments were chosen as a sample for the research.

B- Student sample

After the researchers visited the college sample at the university, they found that the sample of students in the third stage, the researchers found that the number of students in the (2) departments reached (1096) students, as the researchers resorted to using the random method to homogenize the community units, and accordingly a sample of (150) students was chosen from the student community in the College of Education for Pure Sciences at Al-Muthanna University.

Table (1) Distribution of the sample of female students according to the variable of the academic grade

Sample	Variable	Categories	Number
Student sample	Grade	Stage Three	150

C- Research tools

It is a form designed by the researcher to collect data, record it, repeat it, and target units of analysis in the scale (Sultaniya, 2012: 225).

To determine the extent to which the research objectives were achieved, it required the preparation of the following measurement tools:

1- Technological enlightenment scale

Preparing a scale for biological enlightenment requires the following steps:

In light of reviewing the literature and previous studies related to biological enlightenment, and in light of a survey of the opinion of a sample of specialists who conducted previous research on biological enlightenment, from which we extracted certain areas, the researchers built the scale according to the following steps:

- The main areas that make up the scale were identified.
- Formulating the paragraphs that fall under each area.
- Preparing a scale in its initial form, which included (49) paragraphs distributed over (5).
- Presenting the scale to the supervisors in order to choose the appropriateness of the paragraph.
- Modifying the scale in its initial form according to what the supervisors see.
- Presenting the scale to (26) of the arbitrators, and Appendix No. (3) Shows the expert arbitrators who presented the scale to them.
- After making the amendments recommended by the arbitrators, some paragraphs were modified and formulated, and the paragraphs of the scale reached (49) paragraphs after their final formulation distributed over (5) areas, where each paragraph was given a weight according to the five-point Likert scale according to the following table

Table No. (2)

Response	Excellent	Very Good	Good	Acceptable	Weak
Positive Paragraph	5	4	3	2	1
Negative Paragraph	1	2	3	4	5

Thus, the response scores of the study sample individuals on the scale are limited to between (49-245) points. Appendix No. (10) Shows the scale in its final form, which consists of (49) paragraphs distributed over five areas, as shown in the following table:

Table (3)

No	Dimension	Number of paragraphs
1	Cognitive Domain	10
2	Skill Domain	10
3	Affective Domain	10
4	Ethical Domain	10
5	Decision Making Domain	9
Total Score		49

Validity of the scale: The validity of the test means that the test measures what it was designed to measure (Faraj, 1997: 254). It means the degree of achieving the educational goals for which it was designed, and the researchers verified the validity of the scale in two ways:

A- Validity of the arbitrators:

The researchers presented it to a group of experts and specialists, numbering (26) experts, in order to clarify the validity of its paragraphs and to express their suggestions about it or delete it or add what they see fit, and the researchers relied on the agreement rate (90%) of the experts' opinions regarding the validity of the scale's paragraphs, so the researchers made the necessary amendments in light of the experts' opinions, suggestions and comments, according to which the paragraphs were modified and reformulated without deleting any paragraph so that the number of paragraphs of the scale in the final form became (49).

B- Validity of internal consistency:

The validity of the internal consistency of the scale was verified by applying the scale to a survey sample consisting of (150) students who were randomly selected from the College of Education for Pure Sciences / Department of Life Sciences / Al-Muthanna University, and the Pearson correlation coefficient was calculated between each paragraph of the scale and the total score of the field to which it belongs Mechanism, and also Pearson's correlation coefficient was calculated between the scores of each domain of the scale and the total score of the scale, using the statistical program (SPSS).

Scale stability: Scale stability means "obtaining the same results when repeating the measurement using the same tool and the same circumstance" (Agha, 2002: 120).

The researchers took steps to ensure the stability of the scale after applying it to the individuals of the survey sample using two methods, which are the half-split and the Cronbach's alpha coefficient.

A- Split-Half method:

The survey sample scores were used to calculate the stability of the questionnaire using the split-half method, where the score of the first half was calculated for each domain of the scale, as well as the score of the second half of the scores, by calculating the Pearson correlation coefficient between the two halves, then the domain was modified using the Spearman-Brown equation.

B- Cronbach's alpha method:

The researchers used another method of calculating stability, which is the Cronbach's alpha method, to find the stability coefficient of the scale according to the following equation:

The value obtained of the alpha coefficient for each domain of the scale, as well as the scale as a whole, and Table (4) shows this:

Table (4) shows the Cronbach's alpha coefficients for each domain of the scale

Domain	Number of paragraphs	Cronbach's alpha coefficient
First Domain / Cognitive	10	0.941
Second Domain / Skill	10	0.888
Third Domain / Emotional	10	0.894
Fourth Domain / Ethical	10	0.896
Fifth Domain / Decision Making	9	0.900

Test stability:

The test or scale is considered stable if it gives the same results continuously, if it is repeatedly applied to (the same group and the same conditions are met, i.e. the test does not contradict itself, so the stable scale is) (whose scores agree when repeated on the same individuals and under the same conditions) (Al-Harabsheh, 2015: 135) (This means that the relative position of the student does not change if the test is reapplied to the same student once) (another time or re-response to another equivalent test, which means that the concept refers to the extent of stability of the results) (when the test or an equivalent image is repeated on the same group of students) (Al-Mahasneh and Abdul-Hakim, 2013: 88), (as the literature indicates that the test is characterized by stability if its value is stable (0.80) or more) (Abdul-Raouf and Ihab, 2017: 72) (The researchers verified the stability of the test in a way):

1- The split-half method:

(The split method included The midterm split the test into two halves, the first half consists of odd paragraphs, while the second part consists of even paragraphs, then the correlation coefficient is calculated between the two parts (Atwan and Youssef, 2018: 110), as the scores of the survey sample were used to calculate the stability of the achievement test for the fourth scientific grade, which amounted to (200) answer sheets, then the odd paragraphs for each student were collected on the one hand and the even paragraphs on the other hand by calculating the correlation coefficient (Sperman) between the two halves, then the modification was made using the Spearman-Brown equation, (so the stability reached using the Pearson correlation coefficient (0.805), then it was corrected using the Spearman-Brown equation, so it reached) (0.892)

2- Sustainable Development Dimensions Scale

The researchers prepared the Sustainable Development Dimensions Scale, and the scale in its initial form consisted of (50) paragraphs. The preparation of the scale of sustainable development dimensions requires the following steps:

In light of reviewing the literature and previous studies related to sustainable development, and in light of a survey of the opinion of a sample of specialists who conducted previous research, from which we extracted certain fields, the researchers built the scale according to the following steps:

- ✓ The main fields that make up the scale were identified.
- ✓ Formulating the paragraphs that fall under each field.
- ✓ Preparing it as a scale in its initial form that included them.
- ✓ Presenting the scale to specialists and experts in order to choose the appropriateness of the paragraph.
- ✓ Modifying the scale in its initial form according to what the specialists see.

Validity:

The researchers used the apparent validity of the tool by presenting the scale in its initial form to a group of experts who expressed their opinion and did not agree to delete any paragraph from the questionnaire, and their opinions were taken into account for the tool to appear in its final form consisting of (50) paragraphs.

Reliability: The reliability of the questionnaire items was not found. The researchers used the following

method: the retest method, where the test was applied to (40) students, which is the sample selected for the application of the first test. Then the same test was repeated on the same selected group from the sample and after calculating the correlation coefficient using the Pearson equation, the score reached (80) and after correcting it, the score became (82%), as this score is acceptable in the stability of the test.

Fifth: Statistical methods

(The researchers used the statistical program (IBM@ SPSS 25.0) and the following statistical methods in the procedures) (their research and data analysis, and the program (Microsoft Excel 2010) in data processing).

1. (T-Test equation for two independent samples)
2. (T-Test equation for one sample)
3. (Chi-square equation)
4. (Pearson correlation coefficient equation)
5. (Sperman-Brown coefficient equation)
6. (Hypothetical mean equation)

Presentation and interpretation of the results:

(This chapter includes presenting the results reached by the researchers according to the procedures and It was interpreted according to the research objectives, and then came up with a set of conclusions (and recommendations and suggestions as follows):

First: Presenting and interpreting the results

(Since the research objective was to identify biological enlightenment among students of the College of Education for Pure Sciences and its relationship to sustainable development among them, it is necessary to identify the level of biological enlightenment among third-stage students, and also to identify sustainable development among third-stage students, as well as to identify the correlation between biological enlightenment and sustainable development).

• First objective: Identify the level of biological enlightenment among second-stage students.

(Are there statistically significant differences at a significance level of (0.05) between the average scores of the level of biological enlightenment among third-stage students and the hypothetical mean in the biological enlightenment scale)?

(The results indicated that the arithmetic mean of the scores of the research sample of (150) students on the biological enlightenment scale reached (201,800) with a standard deviation of (24,370). To know the significance of the difference between the arithmetic mean and the hypothetical mean, which reached (147), it was found that the difference was statistically significant at (level (0.05), as the calculated T-value reached (65,768), which is greater than the tabular T-value) (1,965) and with a degree of freedom of (149), (which is greater than the hypothetical mean. Table (5) shows this:

Table (5) Significance of the differences between the arithmetic mean, the hypothetical mean, and the T-values of the sample scores on the biological enlightenment scale

Scales	Sampl e numbe r	Arithmeti c mean	Standard deviatio n	Hypotheti cal mean	Calculate d t-value	Tabular t-value	Degree of freedom	Statistical significance
Enlightenm ent	150	201,800	24,370	147	65,768	1.965	149	Statistically significant

Table (5) shows that (the level of biological enlightenment among second-stage students was higher than the hypothetical average, and the researchers attribute this to the lack of academic training programs that focus on the cognitive aspect. The cognitive aspect is characterized by dryness, so we find that students are not interested in it, as it is prone to forgetfulness, in addition to the lack of university interest in enriching curricula with (biological) knowledge without sufficient knowledge of biological knowledge. Study (Zaqout, 2013: 97-

99)

• The second objective: Identifying sustainable development among second-stage students.
(Are there statistically significant differences at a significance level of (0.05) between the average scores of second-stage students and the hypothetical average in the sustainable development scale)?
(The results indicated that the arithmetic mean of the research sample of (150) students on the sustainable development scale reached (132,413) with a standard deviation of (7,579) and to know the significance of the difference between) (the arithmetic mean and the hypothetical mean that It reached (100), it was found that the difference was statistically significant at (level (0.05), as the calculated T-value reached (52.380) which is greater than the tabular T-value) (1.965) and with a degree of freedom of (149), (and this indicates that the fourth grade science students of the dimensions of sustainable development) are greater compared to the hypothetical average, and Table (6) shows this:

Table (6) Significance of the differences between the arithmetic mean, the hypothetical mean, and the T-values of the sample scores in the scale of dimensions of sustainable development

Scales	Sample number	Arithmetic mean	Standard deviation	Hypothetical mean	Calculated t-value	Tabular t-value	Degree of freedom	Statistical significance
Enlightenment	150	132,413	7,579	100	52,380	1.965	149	Statistically significant

Table (6) shows that the level of sustainable development among third-stage students in the biology curriculum was higher than the hypothetical average, and the researchers attribute this to the fact that students at this stage tend to practice the skill of sustainable development because of its direct connection with their cognitive, skill and emotional preparation programs.

•Third objective: Identifying the correlation between biological enlightenment and sustainable development. To verify the hypothesis, the researchers used the correlation coefficient (Pearson) and the t-test and did not find that there was a significant statistical difference, as the value of the correlation coefficient was (0.076), which is less than the tabular value of (0.160), and the calculated t-value was equal to (0.925), which is less than the tabular t-value of (1.96) extracted with a degree of freedom of (148) and at a significance level of (0.05). This indicates that there is no statistically significant difference between the two research variables, as shown in the table below.

Table (7) Correlation coefficient between the average degrees of biological enlightenment and sustainable development

Scales	Sample number	Degree of freedom	Standard deviation	Calculated t-value	Table value	Tabular t-value	Statistical significance
biological enlightenment	150	148	0,076	0.925	0,160	1.965	No Statistically significant

It is clear from Table (7) that there is no correlation between the research variables represented by biological enlightenment and sustainable development. The researchers attribute this to the lack of academic training programs that focus on these important variables in scientific research. Second: Conclusions:

(In light of the research results presented by the researchers, a number of conclusions were reached:

- 1- (The level of biological enlightenment among third-stage students was at a higher level compared to the hypothetical average.
- 2- (The level of sustainable development among third-stage students was at a higher level compared to the hypothetical average.
- 3- There is no correlation between the research variables represented by biological enlightenment and sustainable development.

RECOMMENDATIONS:

(In light of the results reached by the study, the researchers recommend the following):

- 1- (Providing learners with biological knowledge and biological skills to be biologically enlightened).
- 2- (Benefiting from study tools in the process of empowering students and developing and improving their level of performance.
- 3- The necessity of finding a correlation between the research variables represented by biological enlightenment and sustainable development by clarifying the common elements or using teaching methods with practical benefit such as the method of destroying dispersion.

Proposals:

(In light of the current study, what was implemented and the results of the study, the proposals were represented in Conducting studies that focus on the following:

- 1- (Conducting a similar study for students at different educational levels).
- 2- (Comparison between the level of biological enlightenment in different Arab countries.
- 3- (Building programs to provide learners with biological enlightenment as well as scientific and ethical awareness.
- 4- (Building a teaching program through the standards of biological enlightenment and sustainable development).

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