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RESEARCH TITLE

IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOALS IN PHYSICS EDUCATION

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Abstract

This study explains teachers' perspectives on implementing sustainable development-based learning in science and physics subjects. Physics education is a key factor in determining the strength of modern economies and a country's place in the global power equation. This study is a qualitative descriptive study. The ability of Iraq to use physics education and technology for income development and service delivery determines its classification as developed, developing, or undeveloped. We took fifty science and physics teachers as the topic of the study. This research focuses on the available science of physics education as a tool for sustainable development and the strategic approach of science and technology to sustainable development, challenges, and solutions. Interview sheets, questionnaires, and observation sheets were used to collect the information. This research focuses on physics education as a functional science for sustainable development and the strategic approach of science and technology to sustainable development, difficulties, and the way forward. According to the findings, sustainable development is still foreign, and instructors have difficulty integrating sustainable development-based learning. Other findings suggest that the notion of sustainable development may be applied to any research subject having material features related to physics. Therefore, this study can provide a suggestion for sustainable science learning.

Key Words: Sustainable Development Goals, Implementation of Sustainable in Physics, Sustainability Education.

Introduction

Education is unquestionably regarded as the foundation of all significant advancements. Article 35 of the Iraqi constitution stipulates education is a right for all Iraqis, guaranteed by the state by establishing schools, institutes, universities, cultural and educational institutions, and education in them is free. The term education has been defined and abstracted in numerous ways [1], but it is generally understood to refer to the training and illumination of individuals to improve their understanding of the world in which they live. Such information is essential for the advancement of society's living circumstances. Similarly, education is defined as developing an individual's cognitive, affective, and psychomotor domains and abilities for optimal function and performance in society [2]. Individuals must be assisted in maximizing their mental, emotional, and psychological talents to benefit themselves and the society they live in [3]. Submitted that "education is the total process of developing human ability and behaviour's". It is a method of teaching that is designed to convey a mix of information, skills, and understanding that is useful in all aspects of life. Education, in this context, refers to the formal and informal acquisition of knowledge at all levels (primary, secondary, and university). Education is a lifelong formal and informal process that prepares a person to be fully aware of his environment and utilize, control, and dominate it to benefit himself and society. It refers to any method by which a person gets information, understands, or develops skills. It is a method of achieving acculturation in which the individual is assisted in realizing his full potential [4]. There are three routes via which education promotes economic growth: education directly impacts growth even after adjusting for factors such as a country's fertility rate and rate of physical capital investment. This direct effect is believed to represent a favourable influence of a better-educated worker force on a company's ability to adapt and create new technologies increased productivity; higher educational attainment is linked to higher physical capital investment. This factor will become more important in the future because, in an increasingly globalized economy, a country's labour force kills are likely to be crucial in attracting internationally mobile capital; a more educated population has a lower fertility rate and likely more intensive parental investment in each child [5]. It was stated that the astounding heights of educational attainment obtained by modern industrialized nations have substantially explained their development heights, and so education has been generally recognized as a development catalyst. The education sector encompasses cognitive skills, technology, social and political networking abilities, and migration, contributing to economic growth from an international viewpoint. When provided on a large scale, it is the most effective tool for achieving inclusive growth. Education is crucial in lowering unemployment and hence inequality. There aren't many of our assets that have a strong distributive characteristic. With the rapid advancement of service and technology, resource-based growth has displayed major constraints. The implementation of ESD in schools and colleges has been researched in several nations across the globe.

The stories of Australian primary school teachers show how they connected with the materiality of

local locations as an important aspect of sustainable teaching. They found ESD activities in four categories: the materiality of school grounds, links to local locations, community collaborations, and creative processes [6]. The instructor must understand the features of the content, students, and learning objectives to appropriately integrate the ideals of sustainable development in the student's personality [7]. Students are encouraged to reflect on their understanding of sustainability through active teaching approaches. Problem-solving, conversations, debates, presentations, fieldwork, experiments, demonstrations, projects, and cooperative learning all encourage students to develop skills including critical thinking, picturing future possibilities, and making joint decisions. The application of education for sustainable development is examined in this study as feedback for developing educational innovation and change in the Iraqi educational system. This study aims to determine how teachers describe implementing sustainable development-based learning in science and physics subjects.

Education in the available science of physics as a means for sustainable development:

Currently, the 2030 Agenda for Sustainable Development and its Seventeen [8] Sustainable Development Goals (SDGs) [9] place a premium on education that leads to sustainable development. A functional science of physics education, in particular, must be established to continue progress. Physics education based on functional science would enhance scientific-technological and cultural humanistic outcomes. Physics education is critical for any country that aspires to maintain its leadership position in the international world. The quality of a nation's science of physics education might be a better indicator of its technological potential because citizens' technology culture cannot be securely entrenched without the science of physics education [8]. In our current environment, science plays a larger part in physics education than at any previous period in history. Physics can play a significant role in solving many of the human race is experiencing. Politics, socioeconomic circumstances, and public acceptability all play a part in development, but physics, engineering, and other technical and scientific accomplishments may change a developing country into a developed country. We are connected to physics through contemporary technology and Mother Nature on a far more fundamental level. However, it can play a significant role in creating climate change policies, the development of cleaner energy sources, and the development of technical developments. Physics and technology must collaborate to address the need for new technologies that will reduce the harm to our world and address the rising demands on our resources before they are depleted [10]. The support of the science of physics education and research in sustainable development is important because of the following:

1. Physics is a thrilling intellectual adventure that motivates young people and pushes our understanding of nature to new heights.
2. Physics produces vital information for future technology advancements that will continue to power the world's economic engines.

3. Physics contributes to the technical infrastructure and supplies the qualified workers required to benefit from scientific developments and discoveries.

4. Physics is a key part of chemists, engineers, computer scientists, and other physical and medicinal scientific practitioners.

5. Physics contributes to our understanding of other disciplines such as earth, agricultural, chemical, biological, and environmental sciences, astrophysics, and cosmology, all of which are important to all peoples of the globe.

6. Physics enhances people's lives by supplying the foundational knowledge needed to develop novel medical instruments and procedures, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery [11].

Physics Education's Strategic Approach to Science and Technology for Sustainable Development:

We need strong policies and proper execution to help Iraq contribute substantially to the advancement of science, technology, and innovation. First, there is the interconnectivity of the domains science and technology bear. To create the conditions for science and technology capacity to deepen and consolidate, policies affecting human resource development (sound science education, training, and retraining), private sector demand for knowledge, public support for and management of knowledge institutions, and access to information and communication technologies (ICT) infrastructure must be coordinated and harmonized. Science and technology can contribute more to general development when supporting institutions and policies grow stronger [12]. Our main issue in Iraq is putting our solid knowledge and ideas into practice. We must, and I mean MUST, revamp and fine-tune our policies to employ science and technology as a tool for Iraq's economic growth. To do so, we must raise awareness and sensitivity about sustainability and sustainable development challenges and mainstream sustainability and sustainable development into our institutions' teaching, learning, research, and outreach efforts. Local examples and phenomena that pupils are familiar with should be included as much as feasible in pedagogic examples. Student projects should focus on addressing local issues, particularly in the areas around colleges. Students are enticed to think about the Sustainable Creation Goals (SDGs), leading to the development of a generation of future leaders who are "wired" to think about development. The societal advantages of such an orientation of future leaders may be difficult to quantify.

Research Methodology

Mastery experiences, on the whole, are time-dependent and confirm people's conviction in their talents and capabilities to do certain activities effectively. As a result of varied scholastic instructional approaches, instructors educational backgrounds significantly impact their teaching techniques. Most instructors current teaching methods are heavily influenced by their experiences as students during their schooling years.

Consequently, teachers' educational backgrounds and years of teaching experience were used to explain the differences, significantly impacting teachers' teaching practices due to varied academic

instructional models of teachers conceptions of PE. Figure (1) shows physics instructors perspectives about SPE and the parameters used to characterize the participants.

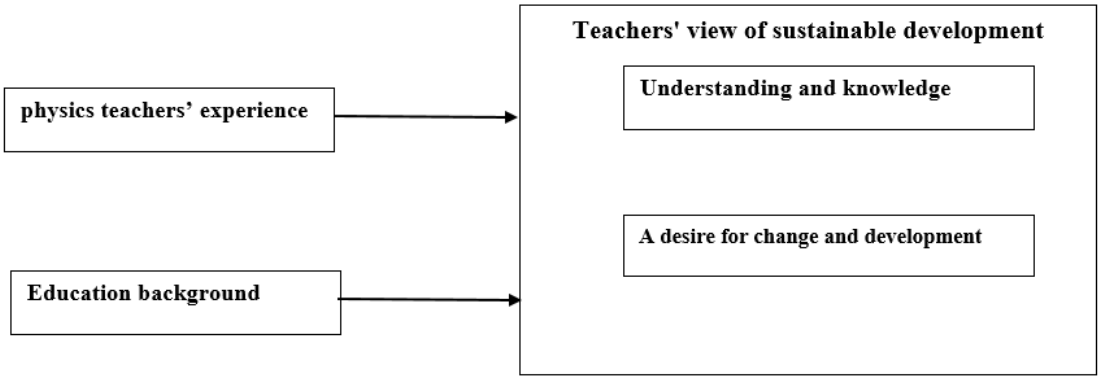

Figure (1): Detailed drawing for the classification of research samples

The survey research was designed to evaluate Iraqi physics teachers perceptions of SPE. We took a sample of 50 physics teachers who volunteered to participate in the study was chosen. This strategy method was chosen because of its ease of data collection, high quality, and cost-effectiveness. The participants of a bachelor degree (22) teachers, while (16) was a master degree and participants of a doctoral degree was (12). Also, we had 10-20 years of teaching experience only (22) participants, (12) who is <10 and (16) more than 20 years of teaching experience, as shown in table (1).

Variable	N
Educational background	
Bachelor	22
Master	16
PhD	12
Physics teaching experiences	
<10 years	12
10-20 years	22
>20 years	16

Table (1): the details of participants by teaching experiences and educational background.

The purpose of this study was to look at how physics teachers perceived SPE in two components (1) Understanding and knowledge of PE (2) A desire for change and development in teaching physics. Data was collected over a four-month period from physics teachers in Wasit who've been attending training workshops. The research survey was conducted at the finish of the training session, which consisted of different statistical questions. Each item was evaluated on a 5-point Likert scale of 'strongly agree' to 'strongly disagree to specify the amount of agreement among participants. An average score for each item was calculated to better understand and convey physics teachers' thoughts on PE. Were required from participants to specify their value towards understanding and knowledge of PE is graded on a five-point scale from "little importance" to "high importance." A total of ten items on understanding and knowledge were created. Table 2 illustrates the result that gets it.

Variable		M	SD	P%
Understanding and knowledge				
1	Have you heard about Education for Sustainable Development?	2.24	1.07	44.8
2	What is your knowledge of the sustainable development goals?	2.1	1.12	42
3	Do you want to know more about sustainable development?	4.68	0.58	93.6
4	Do you wish to merge sustainable development into the school curriculum?	4.54	0.64	90.8
5	Do you like to join forums interested in sustainable development in education?	3.36	1.21	67.2
6	Would you like to meet specialists in the field of sustainable development goals in the field of education?	3.2	1.22	64
7	Do you think "sustainable development" is a way to reduce poverty	3.98	1.01	79.6
8	Do you like to participate in volunteer work for sustainable development goals?	3.06	1.16	61.2
9	Do you want to know more about sustainable development solutions?	3.48	1.37	69.6
10	What is your understanding of the concepts of sustainable development in education?	2.26	1	45.2

Table (2): Questionnaire understanding and knowledge

Finally, participants were asked to respond on a 5-point Likert scale to 10 questions on their desire for change and development. Table 3 illustrates the result that gets it.

Variable		M	SD	P%
a desire for change and development				
1	Do you want to introduce and learn modern technology in teaching?	4.38	0.89	87.6
2	Would you like to do modern technology training at the school you work at?	3.78	1.42	75.6
3	You have the scientific knowledge that makes you master the modern communication technology	3	1.26	60
4	Do you want to replace your old professional experience with modern technology expertise	4.64	0.62	92.8
5	Do you want to dispense with your old teaching methods?	4.16	0.86	83.2
6	Supports administrative change procedures in your educational administration	3.52	1.7	70.4
7	You are ready to change the current teaching style and methods	3.64	1.37	72.8
8	It is difficult for you to understand the working mechanisms of the modern electronic management system	2.18	1.07	43.6
9	The necessity of teacher development before moving to e-administration	3.68	1.38	73.6
10	Do you want to self-employment with education without job conditions?	3.06	1.03	61.2

Table (3): Questionnaire desire for change and development.

The results of the research that show the percentage obtained by teachers for their understanding of

the methods, implementing and teaching sustainable development in schools according to years of experience and academic achievement, to see if there were differences in teaching experiences and educational qualifications between subsamples, a one-way ANOVA was used. Significant differences were detected utilizing Tukey honestly significant difference (HSD) testing for post hoc comparison. SPSS was used to examine the data gathered.

Research Results

Each component's mean value was computed to understand and interpret the physics teachers' perceptions of SPE on understanding and knowledge of physics (M= 3.29, SD= 1.38) and wish for change and development in teaching PE (M= 3.6, SD= 1.4). Figure 2 illustrates the distribution of each component. More than 70% of physics teachers had A desire for change and development in teaching for participants. We carefully analyzed two models of the understanding and knowledge and a desire for change and development in teaching PE, as shown in tables (1) and (2). The answer from some teachers about those questions is shown in Table 1 was high mean value in questions (3,4) the get (93.6,90.8) that mean the teacher want to know more about sustainable development and wish to merge sustainable development into the school curriculum. While question (2) gets a lower mean value (42), teachers don't know the sustainable development goals. The total mean for a questionnaire (Understanding and knowledge) was (M= 3.29), which means the model was neutral.

The answer from some teachers about those questions is shown in Table 2 was high mean value in questions (1,4) the get (87.6,92.8) that mean the teacher want to introduce and learn modern technology in teaching and want to replace their old experiences with modern technical expertise. While question (8) get a lower mean value (43.6), teachers don't have difficulty understanding the working mechanisms of the modern electronic management system. The total mean for a questionnaire (desire for change and development) was (M= 3.6), which means the model was acceptable.

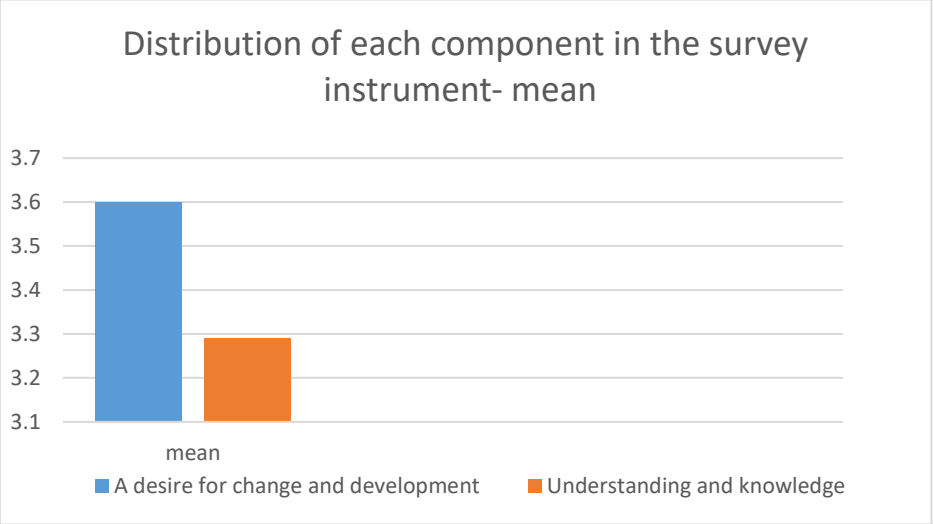

Figure (2): The distribution value for two components in the survey instrument.

Differences in Physics Perceptions of SPE among teachers based on their educational backgrounds and teaching experiences:

Physics teachers with a PhD got the highest mean scores across all components, whereas those with a bachelor's degree had the lowest. As a result, It was logical to assume that physics teachers with more graduate degrees had a better chance of succeeding, had better physics knowledge and comprehension, placed a higher emphasis on physics proficiency and had more difficulties teaching physics. Used a one-way ANOVA to determine how physics teachers' educational backgrounds influenced SPE opinions. The results showed statistically significant differences in PE and difficulty in physics instruction in physics competency for all teachers' educational backgrounds. According to the estimated eta-squared, the mean score differences between groups were moderate. Post hoc comparisons indicated that the PhD group of physics teachers had considerably higher mean scores than the bachelor's and master's degree groups. The bachelor's degree group had lower physics competency scores than the master's degree group, which statistically significant. Using a similar

technique, this study found that the bachelor's group had much lower mean scores in physics teaching difficulty than the master's and doctorate degree groups. There was no statistical difference between the masters and doctorate groups regarding the difficulty of teaching physics. A one-way ANOVA was used to see any differences in subsamples' perceptions of PE. Table 4 show the mean value and standard deviation.

Descriptive

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Bachelor	22	60.05	8.341	1.778	56.35	63.74	45	75
Master	16	75.19	10.772	2.693	69.45	80.93	52	86
PhD	12	80.75	7.238	2.089	76.15	85.35	65	90
Total	50	69.86	12.596	1.781	66.28	73.44	45	90

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3996.378	2	1998.189	24.861	.000
Within Groups	3777.642	47	80.375		
Total	7774.020	49			

Multiple Comparisons Tukey HSD

(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Bachelor	Master	-15.142-*	2.946	.000	-22.27-	-8.01-
	PhD	-20.705-*	3.217	.000	-28.49-	-12.92-
Master	Bachelor	15.142*	2.946	.000	8.01	22.27
	PhD	-5.563-	3.424	.245	-13.85-	2.72
PhD	Bachelor	20.705*	3.217	.000	12.92	28.49
	Master	5.563	3.424	.245	-2.72-	13.85

*. The mean difference is significant at the 0.05 level.

Table (4): The mean difference is significant for educational backgrounds

According to the findings, physics teachers with recent teaching experience of (10-20) years obtained a high mean score in implementing sustainable development in education, adapting to modern technological developments and using them smoothly in education. A one-way ANOVA was used to test if there was any variation in physics instructors' perceptions of SPE, that groups were utilized depending on their teaching experience. All of the physics teaching experience groups had statistically significant differences. Nonetheless, Regarding knowledge and understanding of PE and difficulties in implementing physics education, The mean scores of three physics teaching experience groups demonstrated statistical significance using the Tukey HSD test score for post hoc comparisons. However, physics teachers with fewer than 10 years of experience scored much lower than the other two categories regarding physics proficiency. A one-way ANOVA was used to see any differences in subsamples' perceptions of PE. Table 5 show the mean value and standard deviation.

Descriptive

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10<	12	54.25	5.786	1.670	50.57	57.93	45	65
10-20	22	79.45	7.249	1.545	76.24	82.67	60	90
20>	16	66.31	7.786	1.947	62.16	70.46	52	79
Total	50	69.20	12.380	1.751	65.68	72.72	45	90

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5128.858	2	2564.429	50.618	.000
Within Groups	2381.142	47	50.663		
Total	7510.000	49			

Multiple Comparisons -Tukey HSD

(I) teaching experiences	(J) teaching experiences	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
10<	10-20	-25.205-*	2.554	.000	-31.39-	-19.02-
	20>	-12.063-*	2.718	.000	-18.64-	-5.48-
10-20	10<	25.205*	2.554	.000	19.02	31.39
	20>	13.142*	2.339	.000	7.48	18.80
20>	10<	12.063*	2.718	.000	5.48	18.64
	10-20	-13.142-*	2.339	.000	-18.80-	-7.48-

*. The mean difference is significant at the 0.05 level.

Table (5): The mean difference is significant for teaching experience.

Conclusions

This research assessed physics teachers' impressions of SPE, including their understanding and knowledge of the issues and their ability to adapt to change, progress, and challenges in teaching PE. These findings are reflective of the likelihood of maintaining PE in Iraq. To make it easier for PE to achieve SDGs, it is necessary to 1) Ensure that all schools have a steady supply of credentialed physics instructors, both academically and in terms of training.; and 2) Carefully create and address the professional development needs of physics instructors, with a focus on physics thinking and career awareness. Some of the research's major results include physics teachers' favourable attitudes, suggesting that improved knowledge-seeking skills via the internet may have exposed them to informal PE learning. Moreover, the data show that teachers with higher education degrees have a more comprehensive understanding of PE and have fewer issues giving physics lessons. As a result, it was recommended that beginner teachers' may be a good and long-term resource for implementing SPE in Iraq. However, much research is needed to find the best effective approaches for aiding starting physics teachers' professional and personal growth.

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