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# A Sustainable Development-Oriented, Integrated Approach To Teaching Technology In General Education Schools

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## Abstract

Although the innovative developments brought about by the development of technology had an impact on the teaching methods, the sustainability of technology education was dependent on a conventional notion of craft and the methods used to teach it. It is essential to provide young people, both boys and girls, with a comprehensive knowledge foundation and a fundamental grasp of technology for their future well-being in terms of economic and social growth. To describe potential changes in teachers' notions linked to the teaching techniques of technology and to investigate teachers' opinions on those methods, teachers' assessments of technology and craft education from 2 distinct periods are contrasted in light of 2 distinct national curricula. Critical thinking and knowledge, problem-solving and knowledge, value preference and knowledge, problem-solving and critical thinking, and value preference and issue solving on sustainable development all had a substantial and positive association. Additionally, problem-solving in sustainable development affects knowledge, value choice, and critical thinking. The significance of SD elements being integrated into education at all levels was determined based on the findings.

**Keywords:** teaching, technology education, sustainability, teaching methods,

## 1. Introduction

Innovation and technology are advancing and expanding quickly every day. The necessity for professionals who can use, manage, and plan many technological disciplines is growing in society. Additionally, the concept of educational sustainability encourages the ideas and behaviors that create and drive individuals naturally gravitate toward sustainability. The promotion of sustainable consumption and production can benefit greatly from technology education, which is a component of general education. Adopting innovative teaching techniques to the subject courses is one requirement for ensuring such sustainability.

Since the 2015 SDS, governments and organizations have made numerous initiatives to promote more ecologically friendly behaviors. At the meeting's end, 17 Sustainable Development Goals (SDGs) were established, each of which has a deadline of 2030. An unprecedented global accord led to the achievement of these objectives. These all-encompassing and universal objectives include, but are not limited to, eradicating poverty, safeguarding the environment, and ensuring the prosperous development of all. SDG 4, which emphasises the crucial role of education in creating a just, open, and high-quality society, is one of the declared goals. The need of advancing scientific and practical knowledge to assist SED in education is discussed in Target 4.7. Seven half goals make up the overall goal.

Even though SDG 4 specifically emphasizes education,[4] it is easy to see how this links to the other objectives when you take into account the fact that none of the other goals could be accomplished without sufficient education. For example, SDG 12 highlights the importance of using technology resources sustainably. [5] One of the primary objectives of SDG 9 is the urgent need to develop clean, environmentally friendly technologies while effectively utilizing technology resources. SDG 13 calls for education to expand knowledge and provide society more power to stop the worsening of global warming.

The SDGs' comprehensive scope demands a commitment from every member of society. Teachers and principals who operate in the educational sphere, play a key role in this regard because of their willingness and training. They increase students' sustainability awareness, and thus future citizens' as well, [7]which seems to have a clear impact on society. Actually, by emphasizing the value of teaching people about conditions and events that had an impact on sustainability, many international organizations have maintained their critical function. [8] Programs offered by research universities to promote the expansion of research, chances for interdisciplinary learning, and the transmission of information about sustainability are a few examples.

[9] [10] This claims that research has also been conducted at various educational levels, with a focus on initiatives to reuse technological resources in academic settings or incorporate the SDGs into secondary and primary school curricula. [11-12]The purpose of HESD is to assist students in gaining sustainability-related abilities, knowledge, and mindsets that inform their decision-making for their benefit and the advantage of others, today and future, as well as (ii) taking appropriate action. Over the past several decades, education for sustainable development has been supported and encouraged by international structures like the UN Decade of

Sustainable Development Education [13] and the Global Action Scheme on Sustainable Development Education, both of which are linked by the United Nations Educational.

Higher education institutions can make a substantial contribution to the development of sustainable development since they take on a variety of responsibilities. [14] Some of these include encouraging the creation of spaces where concepts can be freely communicated, assumptions can be questioned, creativity could be fostered, and fresh information can be acquired. Another one is encouraging the growth of future employees as agents of change.

UNESCO's mission requires a variety of teaching and learning techniques because sustainable development was multidisciplinary and much trickier than it first appears. Higher education must develop students' abilities to recognize and appreciate the complexity of sustainability issues and also to critically evaluate their assumptions, attitudes, beliefs, and prejudices while actively participating in the development of solutions. The varied, complex, and divisive nature of sustainability itself presents a multitude of opportunities for logical analysis and skill transmission.

This is unsustainable in students' lives because of the structure of the pedagogy, which disregards the need to address past knowledge and discourses from "a right posture." This is evident even though young people need to get knowledge and comprehension of sustainability issues and adopt the role of pro-sustainability citizens in both thought and action. [15] The existing approach to sustainable growth in higher education, which usually stymies such behavior and thought by being transmissive and lecture-driven, conflicts with the discourse on sustainability in higher education, which advocates for theory and practice through discovery learning. There are a few factors to consider, such as whether there is a disconnect between the transformative element in sustainability constant learning and reality, (ii) what is known about teaching methodologies that could make a difference, and (iii) whether sustainability coursework, as they are conceptualized and implemented at this time, encourage learning that is in line with primary objectives.

## 2. Methodology

To identify the teaching strategies that are most likely to support the long-term viability of modern tech education and the personality growth of students, the research analyzes and compares the developments in Estonian technical topic teaching practices.

### 2.1. Sample

Initially, 157 of the 482 survey questionnaires addressed to the country's general studies school instructors who teach technology and craft education are returned. The author submitted 417 survey questionnaires to technology instructors in general school levels at the start of 2021; 109 of them were returned. Phase 1 refers to the data collection in 2020, while Phase 2 refers to the data collection in 2021. Men made up the bulk of the responders. In Phase 1, there were 149 men and 8 women who responded. 6 women and 103 men responded to the Phase 2 questionnaire. The majority of technical subject teachers are male, and this gender breakdown has remained consistent throughout time.

### 2.2. Instrument

To evaluate the teaching strategies, the researcher invited the instructors of technical topics to express their thoughts on the effectiveness of instruction, its significance in daily life, as well as what they believed to be important in light of the future. The survey that served as the basis for the questionnaire was conducted and translated into Estonian. Objectives, topics, techniques, and material-technical situations were some of the four separate theme blocks that were included in the questionnaire. Only instructors' perspectives on various teaching techniques will be looked at and evaluated in this study. The teachers were asked 36 thoughtful questions about how technology education is taught..

## 3. Method

The average values were used to display the outcomes on the graph after the results were analyzed and the aggregates were compared. The significance of average variances between Phases 1 and 2 was then determined using a t-test. In Figure 1. Additionally, component analysis was employed to pinpoint characteristics with recurring traits and, based on these, to frame the variables defining a more general prevalent aspect. This was done to evaluate the relationships between the main aspects and to decide on latent factors (hidden attributes). The data were processed using the statistical information processing program SPSS 18.0, and a rotated factor matrix was used to determine the levels of the factor weights (Varimax method). In other words, the connection between the quantified features is lowered to the connection between the measured attributes and the common variables as much as possible when using factor structure to express information via a linear system of linked characteristics that best conveys the data's initial relationships. Depending on the factors found, it may be able to highlight changes in instructors' evaluations of teaching approaches over time as well as a bigger, more general explanation of the changes in teaching tactics between Phase 2 and Phase 1.

Taking into account the theoretical and interpretive aspects of the teaching techniques used in technology education as well as the evaluation metrics, the eight-factor prototype, which was created based on the 36 fundamental elements originally provided as questionnaires, turned out to be the most useful. It is feasible to get a more accurate and trustworthy image of general opinions and assessments by substituting the 36 features with the eight variables as opposed to looking at the individual fundamental characteristics one at a time. The features inside the central features are most expressively reflected in the titles of the elements. These descriptions are based on how relevant activities and real-world tasks are incorporated into technology education teaching strategies.

## 4. **Research Findings**

When employing a t-test to compare the survey's questions about the teaching methods in Phases 1 and 2, it became clear that only the statement "Experimenting" showed statistical differences between the average responses from the two studies, p =.034 .05. Comparing the statement to other queries on teaching approaches in 2011, the statement about experimenting showed the highest improvement. M = 4.23, SD = 0.876 for Phase 1 and M = 5.34, SD = 0.921 for Phase 2. Figure 1 displays the means of all questions at various points in time in order of decreasing the overall averages.

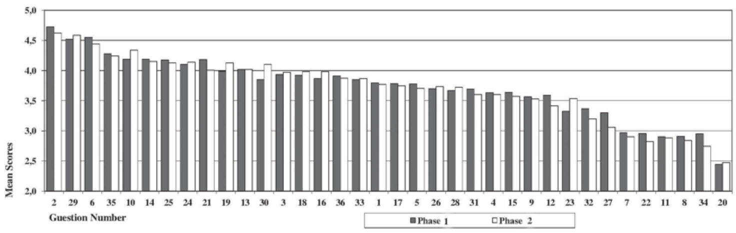


Figure 1. Comparison of the methodical sequence depending on the questionnaires used in Phases 1 and 2

The eight-factor approach built based on 36 fundamental features turned out to be the most effective one when considering both the constructive side and statistical measures. 8 factors seem to describe the 63percent of the overall diversity of the basic features, according to an examination of the teachers' questionnaire findings from Phase 1; eight factors also appear to account for 64% of the overall variability in Phase 2. It's adequate and high enough to consider the model with the 8 elements to be a good one.

It was found that many factors developed that could be referred to by the same term in both research phases: practical action, instructional outing, teacher-centered activity, learner-centered activity, and production activity. Phase 1 and Phase 2 variables were compared for their primary characteristics. However, not all of the variables with the same name have the same essential qualities. In addition, a set of pairings representing three components in the two investigations was not recognized. Tables 1 and 2 for Phases 1 and 2 correspondingly offer a summary of % on a particular element as obtained from the instructors depending on its usefulness or significance, according to the specified assessment scale, to define the factors.

**Table 1 Phase 1 Teaching Methods Factors Distribution in%**

| Factors | Is not usefulor important | Useful or important to a small extent | Useful or important to some extent | Rather usefulor important | Very usefulor important |
|---|---|---|---|---|---|
| *Learner-centered activity* | 20.6 | 17.4 | 20.0 | 21.9 | 20.0 |
| *Research and solving problems* | 19.9 | 17.9 | 25.0 | 18.6 | 18.6 |
| *Practical activity* | 24.2 | 17.8 | 26.1 | 16.6 | 15.3 |
| *Instructions and homework* | 15.5 | 20.6 | 18.1 | 21.9 | 23.9 |
| *Educational outing* | 16.8 | 22.6 | 23.2 | 23.2 | 14.2 |
| *Teacher-centered activity* | 17.8 | 15.9 | 34.4 | 15.3 | 16.6 |
| *Cooperation* | 17.2 | 25.5 | 21.0 | 17.2 | 19.1 |
| *Production activity* | 14.9 | 17.5 | 23.4 | 24.7 | 19.5 |

**Table 2 Phase 2 Teaching Methods Factors Distribution in%**

| Factors | Is not usefulor important | Useful or important to a small extent | Useful or important to some extent | Rather usefulor important | Very usefulor important |
|---|---|---|---|---|---|
| *Learner-centered activity* | 19.3 | 22.0 | 20.2 | 19.3 | 19.3 |
| *Cooperation and solving problems* | 17.4 | 22.0 | 21.1 | 22.9 | 16.5 |
| *Teacher-centered activity* | 20.2 | 29.4 | 12.8 | 21.1 | 16.5 |
| *Educational outing* | 22.9 | 11.0 | 31.2 | 16.5 | 18.3 |
| *Outdoor learning and homework* | 16.5 | 22.9 | 17.4 | 24.8 | 18.3 |
| *Practical activity* | 14.7 | 20.2 | 37.6 | 14.7 | 12.8 |
| *Supervising* | 4.7 | 32.1 | 0.0 | 63.2 | 0.0 |
| *Production activity* | 15.5 | 34.0 | 0.0 | 39.2 | 11.3 |

## 4.1. Common Elements of Phases 1 and 2

Learner-centered activities, practical activities, teacher-centered activities, educational excursions, and production activities are shared elements between Phases 1 and 2.

In the findings of both types of research, the factor learner-centered activity received an excellent evaluation from teachers, with the aspect of utility and importance receiving roughly 80%. (Table 1 and Table 2). The key features of the factor are used to characterize the teaching strategies that are closely associated with the factor, such as working remotely or submitting assignments online, using online resources, using a computer, etc. The very first 6 primary features in Phase 1 exhibit substantial factor loading, with values ranging from.632 to.745. Teachers' high confidence in the factor is demonstrated by the initial 5 main characteristics' significant factor loading in Phase 2, which is appropriately between.615 and.758. Comparatively to Phase 1, the component of Practical activity was evaluated more favorably in Phase 2. Phase 2 instructors are 85.3% more likely than Phase 1 teachers to view this factor as significant or beneficial. Activities required for learners to do practical tasks are included in the factor Practical action, including skills practice.Frontal work, generating equivalent working items at a time, and demonstrating are 2 key features of Phase 2 that distinguish the factor from the central features of the previous Phase; the corresponding component scales are.772 and.506, respectively, demonstrating teachers' high degree of confidence in the factor.

The element Both Phase 1 and Phase II results showed that teacher-centered activities were highly rated by teachers, with Phase 1's results for the utility and importance factor exceeding 82% and Phase 2's results coming in at 77%. (Tables 1 and 2 ). The main traits of the component reflect tasks that are frequently performed by instructors, such as explaining, instructing in work procedures, working with the aid of instructions and guidelines given by the teacher, using books and learning materials, etc. The first two key features in Phase 1 have significant factor loadings.734 and.732 respectively.

All three of the key features in Phase 2 had significant factor loadings.673.694, and.701, respectively, demonstrating teachers' high level of trust in the factor. Phase 1 data for the component **Educational outing** showed that instructors gave it a high rating, with 83% of them rating it as beneficial and important; however, Phase 2 results show that teachers gave it a lower rating, with over 77%. (Tables 1 and 2). The factor's main traits are conversations, visits for educational purposes to businesses, and collaboration with those businesses.

The element In the findings of both research stages, **production activity** received a high rating from teachers, with roughly 85% rating it as important and beneficial shows in Table 1 and 2. Activity that is related to production defines the factor. With comparable factor scales of.751 and.647, the component in Phase 1 has a strong relationship with the central features of production models and frontal activity. Only one of the above key qualities has been highlighted in Phase 2, and instructors have a high level of confidence in it based on the factor scale, which is.726.

### 4.2. Unique Factors in Phase 1

Phase 1 of the project saw the formation of three distinct elements as a consequence of principal component analysis: research and problem-solving; guidelines and homework; and collaboration. According to responses made by more than 80% of the instructors, research and problem-solving are valuable or crucial components of academic work. This includes statements about study, experimentation, and analysis (Table 1). Teachers can have high confidence in the component because it has a good link with the first 3 basic characteristics: addressing and resolving difficult circumstances (r =.737), investigating and experiencing (r =.678), and evaluating (r =.600). Guidelines and homework were viewed as important or valuable by more than 84% of the teachers (Table 1). Workbooks or worksheets, as well as homework, are included in the component as technical exercises that students can complete at home and in their own time. The two main characteristics have factor loadings.769 and.590, etc. The feature of cooperation was viewed as helpful or significant in academic work by more than 82% of the instructors (Table 1). The main elements of group work are strongly correlated with the factor (.795).

### 4.3. Unique Factors in Phase 2

Phase 1 saw the formation of three distinct factors as a consequence of factor analysis: Cooperation and problem-solving; Homework and outdoor learning; Supervision. The element of Working together to treat and resolve difficult situations (.783), having talks (.727), doing analyses (.700), working on projects and teams (.677), working in groups (.609), and experimenting are some examples of tasks where students collaborate (.510). More than 82% of the teachers thought the aspect was helpful or significant for students' academic work. Six of the eight primary qualities have a substantial association with the factor, demonstrating instructors' high level of trust in the factor. The element of Homework and outdoor learning are examples of student activities that are carried out away from the classroom (.588). Correlations are not very strong. More than 95% of teachers thought that Supervising was helpful or crucial for students' academic progress (Table 2). The factor has a high factor score (0.805), which demonstrates teachers' strong trust in the factor. It only has one primary feature, guidance in the work process.

5. **Results**

## 5.1. Analysis of Pre-Test Data Regarding Knowledge, Problem-Solving, Critical Thinking, and Value Preference Regarding Sustainable Development

To determine whether the pre-test behavior of the control and experimental groups differed in terms of knowledge, problem-solving, critical thinking, and value choice for sustainable development, the corresponding null hypothesis was developed.

$H_0$1 There was no discernible difference between the control and experimental groups' pre-test knowledge of sustainable development.

$H_0$2 The pre-test results of the control and experimental groups on sustainable development critical thinking showed no discernible difference.

$H_0$3 There is no discernible difference between the control and experimental groups' pre-test ability on sustainable development problem-solving.

$H_0$4 The pre-test results of the control and experimental groups on value choice for sustainable development did not significantly differ from one another.

The pre-test knowledge, problem-solving, value preference, and critical thinking scores of the control and experimental groups were subjected to a t-test to assess the aforementioned null hypotheses. The outcomes are illustrated in table 3.

**Table 3 T-test results of pre-test results for knowledge, problem-solving, critical thinking, and value choice on sustainable development for the control and experimental groups**

| Variables | Group | Mean of Pre test | N | SD | t | Significance |
|---|---|---|---|---|---|---|
| Knowledge | Experimental | 26.08 | 37 | 7.70 | 0.715 | 0.47 |
| | Control | 27.57 | 35 | 9.89 | | |
| Critical thinkin g | Experimental | 16.35 | 37 | 5.95 | 1.58 | 0.119 |
| | Control | 19.09 | 35 | 8.56 | | |
| Problem-solving | Experimental | 14.05 | 37 | 5.49 | 0.507 | 0.613 |
| | Control | 13.40 | 35 | 5.44 | | |
| Value preference | Experimental | 79.35 | 37 | 7.53 | 1.779 | 0.80 |
| | Control | 82.57 | 35 | 7.82 | | |

Table 3 shows that the t-value of the knowledge test's pre-test is 0.715, which is not statistically significant at the 0.01 level. Therefore, it is not necessary to reject the null hypothesis, which claims that there is no discernible difference in pre-test knowledge of sustainable development between the experimental and control groups. Additionally, the pre-t-value test for critical thinking is 1.58, which is not statistically significant at the 0.01 level. Pre-test results on problem-solving had a t-value of 0.507, which is not significant at the 0.01 level. As a result, the null hypothesis, which states that there is no significant difference between the control and experimental groups' pre-test ability on sustainable development problem-solving, is not rejected. Table 5 also revealed that the t-value of the pre-test on value choice was 1.779, not statistically significant at the 0.01 level. The null hypothesis, which asserts that there is no discernible difference in the pre-test value preference behaviour of the control and experimental groups with regard to sustainable development, is thus rejected.

In terms of knowledge, problem-solving, value choice, and critical thinking for sustainable development, it can therefore be said that there was no variation in pre-test performance between the control and experimental groups.

### 5.2. Analysis of Post-Test Data Regarding Knowledge, Problem-Solving, Value Preference, and Critical Thinking Regarding Sustainable Development

To determine if the control and experimental groups performed differently after the test in terms of knowledge, problem-solving, value choice, and critical thinking for sustainable development, the corresponding null hypothesis was developed.

> $H_0$5 There is no discernible difference between the control and experimental groups' post-test understanding of sustainable development.
>
> $H_0$6 The experimental and control groups performed equally well on the post-test in terms of applying critical thinking to sustainable development.
>
> $H_0$7 In terms of problem-solving linked to sustainable development, there was no appreciable variation in post-test performance between the control and experimental groups.
>
> $H_0$8 The control and experimental groups' post-test findings on value selection for sustainable development don't indicate any discernible changes.

A t-test was performed on the post-test knowledge, problem-solving, value preference, and critical thinking scores of the control and experimental groups to evaluate the aforementioned null hypotheses. Table 4 presents the outcomes.

**Table 4: T-test results of post-test results for knowledge, problem-solving, value preference, and critical thinking on sustainable development in the control and experimental groups**

| Variables | Group | Mean of Post test | N | SD | t | Significance |
|---|---|---|---|---|---|---|
| Knowledge | Experimental | 40.14 | 37 | 11.20 | 2.777 | 0.007 |
| | Control | 33.20 | 35 | 9.90 | | |
| Critical thinkin g | Experimental | 41.68 | 37 | 12.69 | 5.578 | 0.000 |
| | Control | 26.06 | 35 | 10.94 | | |
| Problem-solving | Experimental | 18.65 | 37 | 4.96 | 4.198 | 0.000 |
| | Control | 13.66 | 35 | 5.12 | | |
| Value preference | Experimental | 85.95 | 37 | 7.61 | 0.939 | 0.35 |
| | Control | 84.43 | 35 | 5.96 | | |

Table 4 shows that the post-test t-value for the knowledge test is 2.777, significant at the 0.01 level. As a result, there is a notable difference between the experimental and control groups' post-test knowledge of sustainable development. Additionally, the t-value of the critical thinking post-test is 5.578, which is significant at the level of 0.01. As a result, there is a substantial difference between the experimental and control groups' post-test scores on the critical thinking component of sustainable development.

The problem-solving post-test's t-value is 4.198, which is significant at the level of 0.01. Therefore, the null hypothesis claiming that there is no discernible difference between the experimental and control groups' post-test performance on sustainable development problem-solving is rejected. As a result, there is a substantial difference between the experimental and control groups' post-test efficiency in sustainable development problem-solving. Table 4 further revealed that the post-test's t-value on value preference was 0.939, not statistically significant at the 0.01 level. As a result, it is determined that the experimental treatment of ESD caused a difference between the control and experimental groups on post-test assessments of critical thinking, problem-solving, and knowledge of sustainable development. Additionally, there was no distinction between the control and experimental groups' post-test assessments of value preference as a consequence of the experimental procedure of ESD.

### 5.3. Data analysis regarding the impact of an integrated method on education for SD on SDK

The following null hypotheses were created to ascertain the effect of an integrated approach to education for sustainable development on students in upper primary school's knowledge of sustainable development.

$H_0$9 When pre-test knowledge and IQ were included as covariates, there was no discernible difference between the experimental and control groups' knowledge of sustainable development.

$H_0$10 When pre-test knowledge and intelligence were included as covariates, there was no discernible gender difference in the experimental group's knowledge of sustainable development.

Each of the aforementioned null hypotheses is put to the test separately. They provide a tabular breakdown of their analysis along with their interpretations. Table 5 summarises the mean results from the KTSD for the entire sample (the maximum score was 62), for both the control and experimental groups, both before and after the test.

**Table 5 Average results of the Sustainable Development Knowledge Test for the control and experimental groups**

| Group | N | Mean score | | |
|---|---|---|---|---|
| | | Pre test | Post test | Gain |
| Experimental group | 37 | 26.08 | 40.14 | 14.06 |
| Control group | 35 | 27.57 | 33.20 | 5.63 |

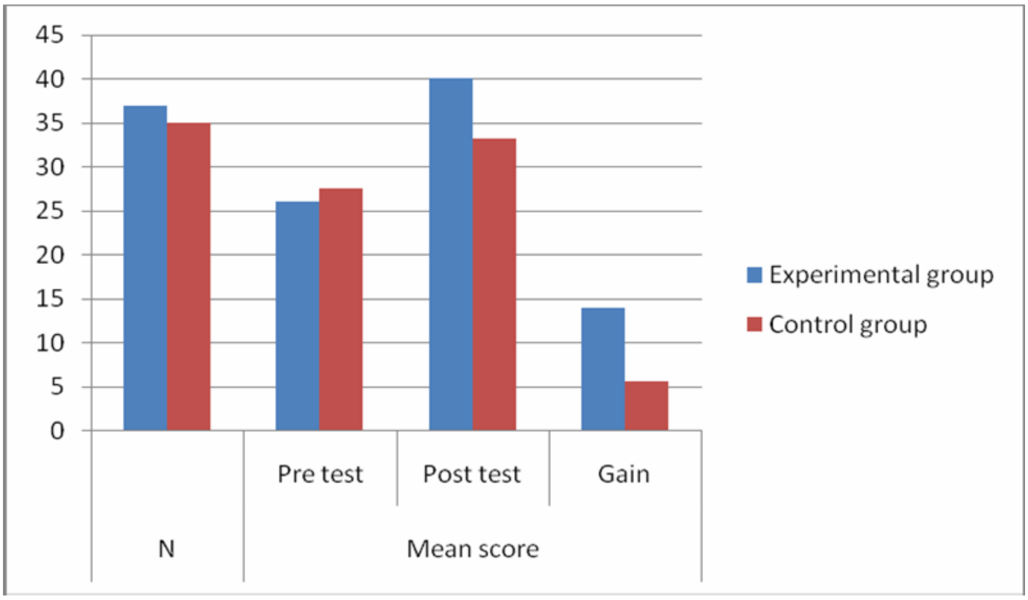


**Figure2: A bar diagram displaying the average results for the experimental and control groups on the Knowledge Test on Sustainable Development**

The post-test scores were subjected to an ANCOVA analysis to determine the statistical importance of the average score, using the pre-test Knowledge Test on Sustainable Development and intelligence scores as covariates. The outcomes are illustrated in Table 6.

**Table 6: Analysis of the correlation between knowledge of sustainable development in the control group and the experimental group, using knowledge and intelligence scores from the pre-test as covariates**

| Source | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intelligence | 331.323 | 1 | 331.323 | 5.111 | .027 |
| Pre test on knowledge on SD | 2001.984 | 1 | 2001.984 | 30.882 | .000 |
| Group | 866.437 | 1 | 866.437 | 13.365 | .001 |
| Error | 4408.207 | 68 | 64.827 | | |
| Total | 106031.00 | 72 | | | |
| Corrected Total | 8716.986 | 71 | | | |

**Table 7: the control and experimental groups' adjusted average score when the pre-test was included as a covariate**

| Name of group | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Experimental group | 40.229(a) | 1.341 | 37.552 | 42.905 |
| Control group | 33.101(a) | 1.380 | 30.348 | 35.855 |

According to Table 7, there is a significant difference between the control group and the experimental group's mean post-test scores on the KTSD (F=13.365, p0.01). Therefore, the alternative hypothesis, which states that there is a significant difference in KSD of control and experimental groups when pre-test on intelligence and understanding were considered as covariates, is recognized, and the null hypothesis, which states that there is no substantial difference in KSD of control and experimental group, is denied. Additionally, it can be seen in Table 4.6 that the experimental group's adjusted mean score on the Knowledge Test for Sustainable Development is significantly greater than the control group showing that the incorporated method to education for sustainable development is successful in raising upper primary school students' sustainability knowledge development.

6. **Conclusion**

When the pre-test on problem-solving and intelligence was taken into account as covariates, it was discovered that the integrative system to education for sustainable development was more efficient in enhancing the problem-solving on SD among upper primary school students (F=29.281, p0.01). When the pre-test on problem-solving on SD and intelligence were taken into account as covariates, it was discovered that there was no discernible difference in problem-solving on SD between male and female participants in the experimental group (F=0.78, p>0.05). When the pre-test on problem-solving on SD and IQ was taken into account as covariates, there was a significant difference in problem-solving on SD of the high, mean, and poor knowledge groups of the experimental group (F=10.919, p0.01). Students that did better on the knowledge test had superior sustainable development problem-solving skills. It suggests that students with high or average scores on the knowledge test for sustainable development also had better problem-solving skills in this area.

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