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Research Paper

Examine The Effectiveness of Sustainable Development Learning Modules (SDLM) On the Knowledge, Understanding and Application Domain of Sustainable Competencies Among Secondary School Students

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Abstract
This study aims to evaluate the effect of Sustainable Development Learning Modules (SDLM) on the development of sustainable competencies among secondary school students. The research follows an experimental design, with a sample of 100 students from Khalsa College Public School and PB Memorial Public School in Amritsar. The primary hypothesis tested is that there is no significant difference in sustainable competencies between students taught through (SDLM) and those taught using conventional methods. Statistical analyses of the collected data reveal that (SDLM) significantly enhances students' understanding and application of sustainable development concepts, fostering critical thinking, problem-solving, and a deeper commitment to sustainability. These findings suggest that (SDLM) can be an effective pedagogical tool for promoting sustainable competencies among secondary school students.

Keywords: *Sustainable Development Learning Modules (SDLM), Sustainable Competencies, Knowledge, Understanding and Application Domain.*

I. INTRODUCTION

The concept of sustainable development has been widely discussed and interpreted by scholars, policymakers, and international organizations. While the core idea remains the same ensuring that current development does not compromise future generations' ability to meet their needs different perspectives emphasize various dimensions of sustainability. This definition highlights the necessity of balancing economic, social, and environmental considerations to ensure long-term human and ecological well-being. Similarly, the United Nations has adopted the same definition, reinforcing the importance of intergenerational equity in sustainability discourse. Education plays a vital role in fostering social and emotional development, providing students with opportunities to interact with peers, teachers, and mentors in supportive learning environments. Education helps secondary school students build knowledge and understanding of sustainability by exploring global issues like climate change and social equity. It encourages the practical application of concepts through projects and discussions. This fosters critical thinking and empowers students to contribute to sustainable development in their communities.

NEED OF THE STUDY

The purpose of this study is to evaluate how sustainable development modules affect the environmental competences of secondary school students. It is essential to equip the next generation with the knowledge, understanding, and attitudes necessary to tackle the serious deterioration that ecosystems are experiencing. The study will improve curriculum design and teaching practices by assessing how these educational interventions affect students' competencies and behavior toward sustainability development. The results can help educators and policymakers develop sustainable awareness-raising tactics that will eventually enable students to take an active

role in bringing about environmental change.

OBJECTIVES OF THE STUDY

1. To examine the effect of sustainable development learning modules on the sustainable competencies of secondary school students.

HYPOTHESES OF THE STUDY

I. There is no significant differences exist in the sustainable competencies of secondary school students taught through sustainable development learning modules (SDLM) and those taught using conventional methods.

a) There is no significant differences exist in the knowledge domain of students belonging to Experimental group and Control Group.

b) There is no significant differences exist in the understanding domain of students belonging to Experimental group and Control Group.

c) There is no significant differences exist in the application domain of students belonging to Experimental group and Control Group.

II. METHODS AND PROCEDURE

Design: The present study falls in the domain of experimental research.
Sample: Adequate sample comprising of 100 secondary school students studying in Khalsa College Public School, Amritsar and PB Memorial Public School were selected for the purpose of this study.

TOOLS USED

- Self-constructed Sustainable Development Learning Modules (SDLM) on sustainable competencies of 9th-grade students.
- Intelligence Test developed by G. C. Ahuja (2005).

ANALYSIS OF DATA

The investigator used mean, S.D, 't' test used to find significant differences in the mean scores of sustainable competencies between the experimental group and the control group.

Hypothesis-1"There is no significant differences exist in the sustainable competencies of secondary school students taught through sustainable development learning modules and those taught using conventional methods." In order to test this hypothesis, post test scores of both the control and the experimental group were tabulated and analyzed through SPSS and the results have been entered in Table 4.1.

TABLE 4.1
't'-ratio of mean scores of experimental and control group in post test

Groups	N	Mean	S.D.	$S.E_d$	Mean Diff.	Df	t-Value	Inferences
Control	50	22.68	3.40	.66544	4.32	98	6.492	Significant at 0.05 level
Experimental	50	27.00	3.24					

The results showed that students in the experimental group, who were taught using sustainable development learning modules, had a significantly higher mean score (M= 27.00) compared to those in the control group (M = 22.68). The t-value of 6.492 was found to be statistically significant at a 0.05 level of significance.This indicates that a significant difference exists in the sustainable competencies of secondary school students taught through sustainable development learning modules compared to those taught using conventional methods.

Further, Table 4.1 reveals that the mean scores of the Experimental and Control groups are 27 and 22.68, respectively. The higher mean scores of Experimental Group indicates that the group taught using sustainable development learning modules exhibited better performance in sustainable competencies compared to the group that was given no treatment at all. The graphical representation of these results is presented in Figure 4.1

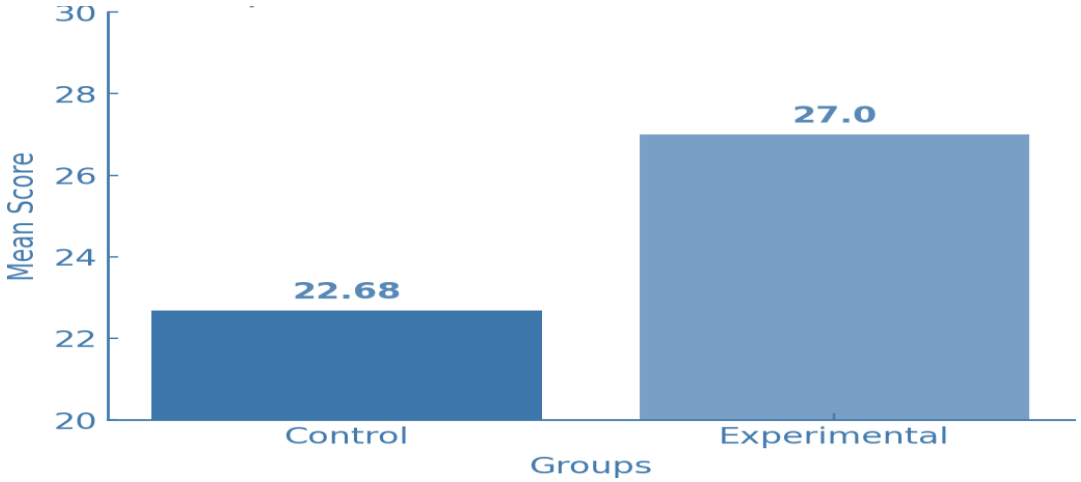

Fig 4.1Mean Score Values of Experimental Group and Control Group

Therefore, Hypothesis-I namely "No significant differences exist in the sustainable competencies of secondary school students taught through sustainable development learning modules and those taught using conventional methods." is rejected.

The comparatively higher sustainable competencies observed in the students exposed to the Sustainable Development Learning Modules may be due to several probable factors. The modules may have helped students retain and apply sustainability concepts more effectively by incorporating hands-on activities and real-world applications. Their multidisciplinary content—possibly integrating environmental science, economics, and social responsibility—might have provided a more holistic understanding of sustainability issues. Students may have improved their critical thinking and decision-making skills through engagement with real-world sustainability challenges.

Group discussions and teamwork could have played a role in communication, leadership, and collaborative problem-solving. The emphasis on interactive and participatory learning, rather than passive listening, might have increased student motivation and engagement. The use of digital tools—such as simulations, videos, and case studies—may have made learning more accessible and relatable. Frequent assessments and reflective exercises possibly encouraged deeper processing of concepts. Additionally, brainstorming activities and opportunities for innovation could have inspired students to generate sustainable solutions. The results of our study are in consonance with the studies conducted by and Wiek et al. (2011), Sterling (2012) and Barth et al. (2014), who emphasized that the active, student-centered learning is very effective in sustainability education.

However, our results are not in consonance with the studies conducted by some researchers, Panda (2001) and Jayashree (2007), who concluded that conventional teaching methods still play a significant role in acquiring sustainability competencies and that structured modules may not always yield superior results in all educational contexts.In order to further study whether the students differed in three different domains viz: Knowledge, Understanding and Application, scores obtained by students in different domains were separately scored and the data was analyzed to test the following hypotheses.

HYPOTHESIS I (a) *"There is no significant differences exist in the knowledge domain of students belonging to Experimental group and Control Group."*

To test this hypothesis, post-test scores of students in both the control and experimental groups, specifically for the knowledge domain, were tabulated and analyzed using SPSS and the results are entered in Table 4.2.

TABLE 4.2
Mean Scores of Experimental and Control Group in the Knowledge Domain

Group	N	Mean	S.D.	S.Ed	Mean Diff.	df	t-value	Inferences
Control	50	7.10	1.23	0.3436	0.42	98	1.222	Not Sig. at 0.05 level
Experimental	50	6.68	1.30					

The analysis revealed that the mean score of the control group (M = 7.10) was slightly higher than that of the experimental group (M = 6.68). The calculated t-value of 1.22, was found to be statistically not significant which was less than the critical value at the 0.05 level of significance.Table 4.2 indicates that the calculated t-value (1.222) is not significant at the 0.05 level. This implies that there is no statistically significant difference in the

knowledge domain of students taught through sustainable development learning modules and those taught using conventional methods.
Visual representation is being given in Figure 4.2.

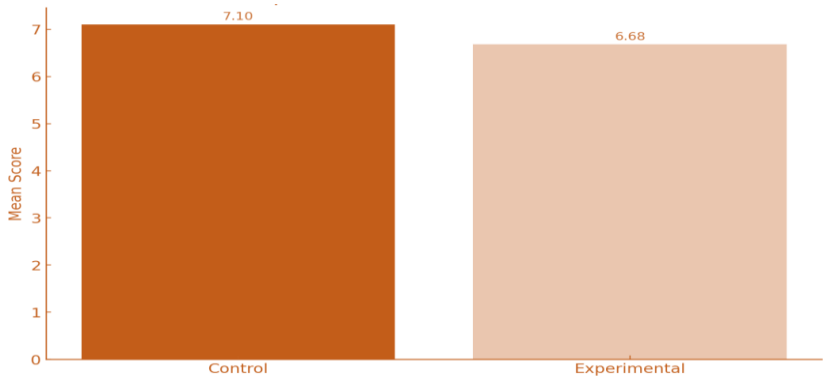

Fig 4.2: Mean Scores of Experimental and Control Group in the Knowledge Domain

Hence, The sub-hypothesis, namely "No significant differences exist in the knowledge domain of students belonging to Experimental group and Control Group.", is retained. These findings suggest that while innovative teaching approaches like sustainable development learning modules may positively influence other domains of learning, they did not lead to significantly better performance in the knowledge domain when compared to traditional teaching methods.The lack of significant difference in knowledge scores may be due to both teaching methods effectively conveying basic facts and concepts, resulting in comparable performance. As educators often focus on knowledge delivery, students in both groups likely received sufficient information. However, the real value of sustainable development modules lies in promoting deeper understanding, critical thinking, and practical application—areas where differences may emerge more clearly than in knowledge acquisition alone. This result is in consonance with findings by Mishra (2004) and Rao (2009), who asserted that basic knowledge and factual content are often equally well conveyed through conventional pedagogical approaches. However, it is not in consonance with the findings of Tilbury (2011) and Cebrián et al. (2015), who emphasized the role of participatory and contextual learning strategies in enhancing knowledge acquisition in sustainability education.

HYPOTHESES I (b). *"No significant differences exist in the understanding domain of students belonging to Experimental group and Control Group."*
To test this hypothesis, post-test scores of students from both the control and experimental groups, specifically in the understanding domain, were tabulated and analyzed using SPSS and have been entered in Table 4.3. The statistical results are presented in Table 4.3.

TABLE 4.3
Mean Scores of Experimental and Control Group in the Understanding Domain

Group	N	Mean	S.D.	S.Ed	Mean Difference	df	t- value	Inferences
Control	50	8.06	1.89123	0.3176	2.90	98	9.138	Significant at 0.05 level
Experimental	50	10.96	2.00432					

The results showed that the experimental group scored significantly higher (M = 10.96) compared to the control group (M = 8.06) in the understanding-based questions. The t-value of 9.138 was found to be statistically significant, which exceeds the critical value at the 0.05 level of significance, indicating a meaningful difference.This indicates a statistically significant difference in the understanding domain scores between students taught using sustainable development learning modules and those taught through conventional methods. The higher mean score of the experimental group (M = 10.96) suggests that the experimental group outperformed the control group in the understanding domain, likely due to the treatment or intervention they received. This indicates that the approach used in the experimental group was more effective in enhancing comprehension and understanding of the subject compared to the control group, which did not receive the same treatment. The difference in mean scores is also illustrated in Figure 4.3.

Fig 4.3: Mean Scores of Experimental And Control Group in the Understanding Domain

As a result, the Sub-Hypothesis, namely "No significant differences exist in the understanding domain of students belonging to Experimental group and Control Group", stands rejected. This finding suggests that students who were taught through sustainable development learning modules demonstrated a significantly higher level of understanding of sustainability-related concepts than those taught through traditional teaching methods. The higher scores in the understanding domain can be attributed to the sustainable development learning modules' emphasis on conceptual clarity, contextual learning, and student-centered strategies. By incorporating real-life examples, discussions, reflective activities, and interactive tools like case studies and visual aids, the modules enable learners to connect theory with practice and view issues from multiple perspectives. This approach fosters deeper comprehension, critical thinking, and internalization of content—outcomes that traditional lecture-based methods often fail to achieve. These results are in alignment with the findings of Tilbury (2011), Sterling (2012), and Barth et al. (2014), who have emphasized the importance and impact of active learning strategies and participatory methods in fostering deeper comprehension in sustainability education.

HYPOTHESIS I (c).*"No significant differences exist in the application domain of students belonging to Experimental group and Control Group."*
To test this hypothesis, the post-test scores of students from both the control and experimental groups were analyzed using SPSS with respect to the application domain. The results are being entered in Table 4.4.

TABLE 4.4
Mean Scores of Experimental and Control Group in the Application Domain

Group	N	Mean	S.D.	S.Ed	Mean Difference	df	t-value	Inferences
Control	50	7.52	1.58010	0.3169	2.22	98	7.005	Significant at 0.05 Level
Experimental	50	9.74	1.58835					

The results indicated that the experimental group achieved a higher mean score (M = 9.74) compared to the control group (M = 7.52). The t-value of 7.005 was found to be statistically significant, which exceeds the critical value at the 0.05 level of significance.The higher mean scores of Experimental group in Application Domain clearly indicates that students taught using sustainable development learning modules performed better than those that were not given any treatment. The comparative results are also illustrated in Figure 4.4.

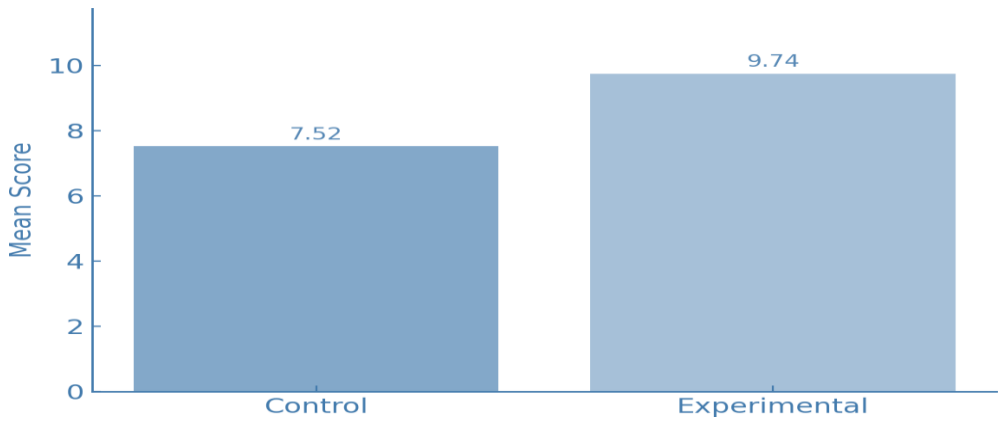

Fig 4.4 Mean Scores of Experimental and Control Group in the Application Domain

Hence, the Sub-Hypothesis, namely "No significant differences exist in the application domain of students belonging to Experimental group and Control Group.", is rejected. This result clearly indicates that the use of sustainable development learning modules significantly improved students' ability to apply sustainability concepts in practical or real-life contexts compared to conventional methods. The higher scores in the application domain can be attributed to the sustainable development learning modules' focus on real-world contexts and experiential learning, which enabled students to move beyond theoretical understanding to practical application. Through activities such as simulations, problem-solving tasks, case studies, and scenario-based discussions, students actively engaged in applying concepts to meaningful situations. This interactive and constructivist approach nurtured higher-order thinking skills, encouraging decision-making, analysis, and solution development related to sustainability issues. By providing repeated opportunities for practice and reflection, the modules effectively enhanced students' ability to transfer their learning to real-life contexts. These findings are consistent with the research of Wiek et al. (2011), Sterling (2012), and Barth et al. (2014), who highlight the effectiveness of experiential and problem- based learning approaches in enhancing students' application skills in sustainability education.

The findings of Sub-Hypotheses I (b) and I (c) further support the results of Hypothesis I confirming that a significant difference exists in the sustainable competencies between students in the experimental and control groups.

Educational Implications and Conclusion

The study affirms the value of integrating sustainability education into mainstream curriculum using well-designed, interactive learning modules.The significant improvement in students' understanding and application domains highlights the importance of moving beyond rote learning to include experiential and problem-based learning strategies. Educators should be encouraged and trained to use interdisciplinary approaches when teaching sustainability, connecting environmental, social, and economic aspects. The findings support policy-level recommendations for including sustainability education as a mandatory component of teacher training and school curricula. Thus, schools and educational institutions should provide adequate resources and infrastructure to support the use of sustainability modules, including digital content, collaborative projects, and field-based learning.

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