

Vol. 21 No.2 March - April 2026



Interdisciplinary Research Review

ISSN 2697-536X (Online)

Interdisciplinary Research Review

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Publisher : Editorial Office of Interdisciplinary Research Review, Interdisciplinary Committee for Research and Development, the Royal Society of Thailand

Origin : The Interdisciplinary Research Review was established with the cooperation of four institutes:

1. The Royal Society of Thailand Committee of Interdisciplinary Research and Development
2. Phetchaburi Rajabhat University
3. Interdisciplinary Research Foundation
4. Kanchanaburi Rajabhat University

Objectives of journal

1. To encourage and publish knowledge and useful opinions in any field of study
2. To support academicians and teachers in creating work beneficial to the academic community
3. To stimulate and support education at the university level

Policies of the journal :

The Interdisciplinary Research Review (IRR) publishes six issues per year. All submitted articles are subject to peer review, and must be approved by two experts in the relevant field prior to acceptance. Prior to review, all articles must pass a screening process which evaluates the articles' appropriateness for the journal, originality, proper formatting, and English proficiency. All material in each article that is not original must be properly referenced to the published literature. The editors reserve the right to modify articles in the interests of clarity and proper English usage. The opinions and views expressed in the journal are those of the authors of the respective articles and not those of the editors or publisher.

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Contents

Volume 21, No. 2, March – April 2026

	Page
Satisfaction evaluation of the Green Office (GO) projects in Thailand: A step towards achieving continuous sustainability	1
Sayam Aroonsrimorakot, Kampanad Bhaktikul, Meena Laiphrakpam, Suthep Mungkhun, Kornkanok Sarapirom and Piyaruk Pradabphettrat	
Community-Based Peace Education Framework for Sustainable and Transformative Peacebuilding	17
Bryan M. Floro	
Effect of Emulgel containing Langkasuka Oil versus Diclofenac Gel for Improving Physical Function in Patients with Knee Osteoarthritis: A randomized controlled trial	27
Kulkamol Vannasri, Suwanna Maenpuen and Prakairat Tunit	

Editorial Note

The Interdisciplinary Research Review (IRR) was established with academic cooperation by The Royal Society of Thailand Committee of Interdisciplinary Research and Development, Rajabhat University (Western Group), and Rajamangala University of Technology Rattanakosin. This Issue, Volume 21, No. 2, March – April 2026. This issue contains of four interesting articles in multidisciplinary fields: (1) Satisfaction evaluation of the Green Office (GO) projects in Thailand: A step towards achieving continuous sustainability,(2) Community-Based Peace Education Framework for Sustainable and Transformative Peacebuilding ,(3)Effect of Emulgel containing Langkasuka Oil versus Diclofenac Gel for Improving Physical Function in Patients with Knee Osteoarthritis: A randomized controlled trial.

The Editorial Board of the IRR encourages anyone to submit articles for evaluation and review. The processes of submission, review and publication of articles are described on the journal's website, <https://www.tci-thaijo.org/index.php/jtir>. The Editorial Board and Committees of the IRR sincerely thank all peer reviewers who have sacrificed their time to help us produce a better journal, and also wish to thank all teachers, researchers and other academicians for submitting their valuable research to this journal. Finally, we thank readers of our journal who help to spread the knowledge and benefits gained to others. With your feedback and suggestions, we will strive to improve the quality and relevance of the IRR.

Yongyudh Vajaradul
Editor
Interdisciplinary Research Review



Satisfaction evaluation of the Green Office (GO) projects in Thailand: A step towards achieving continuous sustainability

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Abstract

This article aims to evaluate satisfaction with the continuity of the Green Office project's performance and to present an evaluation of the GO projects in Thailand in terms of environmental, economic, and social performance. The study evaluated the operation of twenty activities, such as information on Greenhouse gas emissions, initiatives to publicize the office staff, consumption of water, energy, paper, management of waste, seminars, meetings, procurement, etc., by collecting data from administrators and operators, using a questionnaire from 73 offices during 2015 to 2017. An in-depth interview was also conducted with 25 key respondents. Satisfaction evaluation revealed that 86.0% of operators were satisfied with the staff's knowledge, intelligence, and awareness of the operating steps of GO, followed by satisfaction that participation in the GO project has promoted the staff's quality of work and life (80.82 percent). Also, 90.41% of administrators were satisfied with the view that the GO project increased the knowledge about the GO operation procedure, and 89.04% were satisfied as the GO project has awarded certificate trophies to offices based on the auditing score. Finally concluded that the GO project in Thailand brings satisfaction to offices in terms of economy, society, and the environment.

Keywords: Environment, Green Office Thailand, Satisfaction, Continuity, Sustainability

Article history: Received 13 March 2026, Revised 20 April 2026, Accepted 22 April 2026

1. Introduction

Nowadays, every nook and corner of the world has been experiencing the impact of climate change, which has resulted in lots of discussion among scholars, academicians, and scientists on the global environmental problems, including pollution, increase of the global surface temperature, ozone depletion, reduction of natural resources, etc. [1,2,3].

Careless use of natural resources, and unsustainable ways of mankind, for example, using diesel, petroleum, and other fuels for industrial usage, to drive vehicles, or generate electricity, which release large quantities of Carbon dioxide, cause these negative impacts on the environment [4,5,6]. Consequently, there are operating steps for leading towards sustainability, that pressurize all kinds of

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organizations worldwide to include the element of sustainability in the management and working process, with due consideration of emissions, generated waste and disposal, and energy usage [7, 8, 9], including regions of hot weather like Thailand leading to the reduction of energy usage even by 16.56 percent due to the development of innovative energy saving guidelines in air conditioning systems[10]. The GO Project has been operating continuously under the sponsorship of the Department of Environmental Quality Promotion(DEQP), Thailand to promote sustainability in the daily office operations. Sustainability is composed of three elements, including environmental, economic, and social sustainability [11]. As sustainability has been defined as meeting current needs without compromising the abilities of future generations [12], it is closely related to human activity, which is responsible for significantly intensifying the greenhouse effect [13]. The main issue of environmental sustainability is minimizing the impact of organizational activities on the environment, and identifying the sources of environmental problems with standardized environmental management systems such as ISO 14001 [14]. This standard aims to improve the environmental performance of an organization by following the procedure of evaluation. More specifically, the procedure encompasses auditing, evaluation of performance, etc. [15,16].

Recent studies have also reported on managing and reducing GHG emissions, electricity and water consumption, waste generation, and air pollution [17,18,19]. Minimizing the impact of climate change requires substantial human efforts to achieve reductions in greenhouse gas emissions in the coming decades through changes in our economy, system of production, and consumption behavior [20, 21]. Even though this change focuses mostly on the government and industrial sector, we need changes at the individual, household, and community level

because it has been estimated that 2/3 of the world's emitted GHGs have been caused by people's latent or manifest behavior and practices [22]. Environmental sustainability has become an ethical and strategic imperative for organizations, and more and more employees are interested, encouraged, or instructed to act in environmentally sustainable ways. Consistent with current societal and workplace trends regarding environmental sustainability, there are prominent theoretical frameworks from social and environmental psychology that influence employee green behavior (EGB). This includes the theory of planned behavior, which suggests that people's attitudes, subjective norms, and perceived behavioral control predict their intentions, resulting in behavior change, such as the use of environmentally sustainable packaging, and an employee's intention to go by public bus [23]. Since many organizations now include environmental sustainability goals in their strategy, organizational scholars and psychologists have increasingly studied employee green behavior (EGB). Characteristics of EGB include a meaningful set of employee behaviors that contribute to the shared organizational goal of promoting environmental sustainability (e.g., creating sustainable products or delivering services in sustainable ways [24]. Thus, employees' behavior can be evaluated in terms of its contribution toward (or detracting from) these goals [25].

So, we need to evaluate factors that help in adopting sustainable behaviors to reduce GHG emissions [26]. It is commonly seen that workplaces worldwide are a major source of carbon emissions, and CO₂ emissions due to energy usage are estimated to increase to 720.5 million tons in the year 2050 from 188.0 million tons in 2010 [27]. So, attitude and behavioral change in energy usage, such as the adoption of energy-saving habits of employees and behavioral interventions in the office environment, a sustainable green management

system (SGMS) saves energy, and also helps to reduce the impact of carbon dioxide emissions on the environment [28,29].

Department of Environmental Quality Promotion (DEQP) Thailand is an organization that assists with projects of good management for environmental sustainability, and one such prominent project is the Green Office (GO). DEQP has developed a criterion, tested it, and evaluated participating offices that meet the criteria to certify as green offices starting in 2013. Gradually, GO upgraded the environmentally safe offices and extended the certification of offices to all kinds of organizations, both public and private, as qualified green office standards. The main aim

of GO is to change office staff's ways of using office resources to save resources for minimizing global warming and other impacts on the environment, which have increased due to the reckless behavior of human beings, that increases GHG emissions without consideration of the natural environment [30]. The green office has been set up to promote sustainable work practices in the office work process through the provision of training and education programs among the office staff to increase environmental awareness on the effects of climate alteration and adopt practices through behavioral changes and usage of innovative energy-saving products [31]. The main elements of the GO Management System, adapted from [12], are given below in Figure 1.



Figure 1. Elements of the Green Office Management System

The working principles of GO practices are designed to minimize generated office waste through situational behavioral changes such as the adoption of sustainable meetings, saving resources such as paper, ink, and energy, recycling office wastes, refraining from using harmful insecticides and chemicals, and promote purchasing of environmentally

friendly office utilities and services [32, 33, 34, 35]. So, all organizations need to pass the GO standards as these will encourage these offices to save resources, reduce generated waste, and if generated waste, recycle it for further usage. This suggests that to qualify for the GO standard, participating offices encourage office staff to minimize the use of

energy, water, and other resources, switch to renewable energy, reduce PM_{2.5} and other impacts due to environmental pollution, promote reusing and recycling waste, consider using innovative eco-friendly office furniture, space, design, and construction [36].

1.2 Research Objectives

The objectives of this research paper are:

- 1) to evaluate satisfaction with the continuity of green office projects' performance
- 2) to present an evaluation of the Green Office projects in Thailand in terms of environmental, economic, and social performance

2. Methodology

The satisfaction of the green offices' project operation in Thailand was evaluated with a focus on the performance procedure of GO under the sponsorship of DEQP in the following ways:

1. Formation of a managerial committee, comprising an auditor, board members, and other team members with a specific responsibility.
2. Preparation and setting up of guidelines for participating offices that apply to get the GO Standards.
3. Organization of operational training program for participating offices on GO operations and how to maintain it continuously.
4. Evaluation and decision for qualifying organizations to be awarded green office standard certificates in different strata in terms of the office's performance on environmental safety and consideration.

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4. Evaluation and decision for qualifying organizations to be awarded green office standard certificates in different strata in terms

of the office's performance on environmental safety and consideration.

2.1 Green office evaluation criteria

Table 1. Green office evaluation criteria (New)

Criteria
Evaluate specific policies, plan ways of office performance, pattern of resource usage, impart awareness, green office laws, and rules, collect data on GHG, plan for continuous improvement, and administrative section review
Evaluate established channels for communication, awareness, training, knowledge sharing, understanding, publicity, and campaigning
Evaluate energy and other resource consumption
Evaluate steps for minimizing waste and reusing generated waste
Evaluate steps to preserve a safe environment on the usage of air, light, sound, livability, and emergency preparedness
Evaluate office procurement

2.2 Procedure for joining the Green Office Project

Table 2. Procedure for joining the Green Office Project

Step	Procedure
1	Any office can send a completed application form to check the quality of the office and to get the award for the GO project.
2	Submit to the management team of DEQP the introductory document for evaluation
3	If the office is qualified for the introductory evaluation, it should be informed.
4.	All participating office staff should be provided facilities to receive training and education on practicing green office
5.	Visit the office to recommend for improvement
6.	Each area committee should evaluate the performance of applicant offices
7.	The responsible national committee should reevaluate offices that scored 90 percent in all criteria.
8.	The evaluation result of the committee should be summarized in a meeting of DEQP.
9.	Finally, the results of the successful applicants should be announced on DEQP's website

The participant offices were evaluated to check whether they followed the green office's criteria. After the assessment, the result scores were prepared for awarding the GO trophies. Qualified satisfactory offices were awarded the green office trophies, divided into three levels: 1. Gold (90% and above); 2. Silver (80% to 89%); 3. Bronze (60% to 79%). If an office scored less than 60%, it is considered to be unqualified for awarding the trophies [37].

2.3 Tools employed for data collection

This research used many techniques for data collection, notably questionnaires, in-depth interviews, and literature review. Researchers used both primary data (obtained from a questionnaire) and secondary data (obtained by reviewing the literature of previous research) for evaluation. For evaluating the offices that applied for

certification as qualified GO standards, data was collected during the years 2015 to 2017. The main tool used for collecting data was a mail questionnaire set in the Thai language, as it is a convenient tool for collecting data for a large sample size. The questionnaire was prepared according to the objectives of the research. The questionnaire was divided into two parts, one for operators and the other for administrators, with questions set to examine the status, continuity, benefit, and satisfaction of the GO project. The questionnaire was sent to 207 certified green offices. However, only 73 (35%) offices responded and returned the completed questionnaire. Details of the questionnaire can be seen in Tables 5 and 6. In this study, there was consideration to recruiting only those green offices that have been certified with gold and silver trophies, who have knowledge and awareness about the operating steps of GO, and who could spare time to provide answers to questions of in-depth interviews. 25 key respondents having in-depth knowledge of the procedure and working process of the GO were contacted, and a scheduled time and place for an in-depth interview were fixed. The target objective of evaluating the GO was to find out whether the respondents were satisfied with the working process and continuity of the GO. The selected in-depth interviewees consisted of administrators and working groups. The selected sample respondents for in-depth interview were divided into four groups in terms of area size, such as 1) very large areas above 50,000 square meters (2 agencies were recruited), 2) large areas having 12,500-50,000 square meters (9 agencies were from this group), and 3) small areas having less than 1,500 square meters (5 agencies were from this group). Department of Environment Quality Promotion has given 21 agencies the gold award and 4 agencies the silver award.

2.4 Steps for the evaluation of the Green Office Project operation

The GO research project was evaluated stepwise, as shown below in Table 3.

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Table 3. Stepwise evaluation of the Green office project

Step	Procedure
1	Reviewed and specified the product as the target of the green office criteria
2	Selected the criteria that affect quantitatively
3	Classified the result into the dimensions of economic, social, and environmental
4.	Specified the quantitative result assessment guideline
5.	Calculated the result on each dimension
6.	Compared the result as a unit of economic value
7.	Summed the result up as the total benefit of the project
8.	Evaluated the worthiness of the project

2.5 Background of Financial Proxy Data.

There were two major steps of the Green Office Project operation, namely, giving suggestions and knowledge, and evaluation of the criteria of auditing set up by the audit committee under the sponsorship of DEQP, which financed the operating budget of the Green Office Project, divided into the following budget types:

1. Auditing and registration of the audit committee in the Project.
2. Organizing meetings of the audit committee.
3. Advisors who provide suggestions for improving the green office criteria

4. Auditing offices that have participated in the GO project

Activities of the GO project were evaluated by examining participants' comments given in the GO operation form. The data obtained from these participants of the GO project, which consisted of both quantitative and qualitative data, was analyzed accordingly in a systematic way, including background of previous data, measurement of indicators of GO, and monetization of Financial Proxy (FP). FP was calculated by multiplying the carbon credit cost by the reduced quantity of GHGs, and the result obtained can help decrease the budget allocated for GHG management. Table 4 provides the background of the data listed as an FP.

Table 4. Background of FP data.

Item	unit	mean	min	max
Average rate of water supply cost	m ³	27.50	21.75	29.75
Electricity price per unit	kWh	4.10	3.80	4.50

Item	unit	mean	min	max
Diesel price (2017)	Liter	25.56	21.89	26.79
Gasohol price (2017)	Liter	26.89	24.78	27.98
Paper price (A4)	Ream	120	100	140
Waste management cost	Kg	2	1	6
Wastewater treatment cost for an office size of more than 100 square meters	m ³	4.00	2.00	6.00
The ratio of consumed raw water per water supply, including water leakage in the pipe	m ³	1.44	1.29	1.55
Recycle material price (average)	kg	4.5	3.5	8.95
Training expenditure on the course of Carbon footprint operation(CFO)	Half course	5,000	5,000	5,000
Electricity bill of air purifier for a room size of 60 square meters (Baht/20 staff)	Half year	3,700	2,000	4,000
Training cost for general environmental awareness per person	person	250	100	800
Average Carbon credit price of the T-VERS project (2017)	tCO ₂ e	30	21	100
Water supply cost	m ³	0.15	0.10	0.40

Source: Aroonsrimorakot et al. [30]

The compensation of the GO Project, divided into three dimensions, namely, economic, social, and environmental, was evaluated. From this result, as given in Table 7,

the estimated benefit was obtained. The GO project activities were evaluated to check the benefit/ worthiness of the project, which was calculated by using the formula given in (1).

$\text{The worthiness of the GO Project} = \frac{\text{Benefit-Cost}}{\text{Investment}} \quad (1)$

3. Results and Discussion

The results of the study of the Satisfaction Evaluation of GO Projects in Thailand are discussed in the following headlines:

1. Evaluation to assess satisfaction with the Green Office Project
2. Quantitative evaluation result of the Green Office project
- 3.1 Evaluation to assess satisfaction in the Green Office Project

An evaluation to assess the satisfaction of participants was conducted to investigate the obtained benefits and the opinions of respondents in the operation of future projects. To assess satisfaction in different strata from the office that participates in the GO Project, data were collected from two categories, that is, operators and administrators of the participating offices in the project (Table 5 and Table 6), which contained statements listed to identify the level of satisfaction of respondents from the three categories, namely, High, Medium, and Low.

Table 5. Evaluation for operators to assess contentment in the green office steps

The green office operation steps	Level of satisfaction in percent		
	High	Medium	Low
1. Project publicity, advertising, and an invitation to any offices for participation	47.95	<u>50.68</u>	1.37
2. The office responds to the invitation by sending a completed document of the first round self-assessment form	58.90	39.73	1.37
3. Interested office joins the green office training program	56.16	38.36	5.48
4. GO team visit and provide recommendation criteria for improvement	61.64	31.51	<u>6.85</u>
5. Evaluation of the GO in terms of area by the national committee	72.60	24.66	2.74
6. Based on the evaluation result, the national GO auditors certify offices	<u>79.45</u>	17.81	1.37
7. When the evaluation is concluded, list offices that are qualified and give trophy awards based on the result score	78.08	19.18	2.74
8. Suitability of the duration of the GO project	58.90	35.62	5.48
9. Satisfied with the staff's knowledge, intelligence, and awareness of the operating steps of GO	<u>86.30</u>	12.33	1.37
10. Participation in the GO project led to behavioral changes in staff	76.71	23.29	0.00
11. Participation in the GO project has increased the staff's work efficiency	68.49	30.14	1.37
12. Participation in the GO project resulted in saving resources and reduction of resource consumption	63.01	<u>34.25</u>	2.74
13. Participation in the GO project has promoted the staff's quality of work and life	80.82	17.81	1.37
14. Participation in the GO project trained the office staff to improve continuously to create a sustainable environment at all times	72.60	23.29	<u>5.48</u>
15. To check the efficiency of the GO work procedure and resource consumption, it is essential to collect office operation data continuously	75.34	24.66	0.00

Table 6. Satisfaction evaluation result of administrators in the green office project operation

The green office operation steps	Satisfaction Level in percent		
	High	Medium	Low
1. Joining the GO project provided knowledge to my office about the GO operation procedure	<u>90.41</u>	6.85	0.00
2. The GO project has awarded certificate trophies to my office based on the auditing score	89.04	8.22	0.00
3. The GO project has provided a policy for continuous improvement of the office	84.93	12.33	0.00

The green office operation steps	Satisfaction Level in percent		
	High	Medium	Low
4. Like the policy for renewing the GO certification for improving the office continuously	68.49	<u>17.81</u>	<u>9.59</u>
5. To check the efficiency and improvement of the GO work procedure and resource consumption, it is essential to collect office operation data continuously by the concerned GO team	83.56	13.70	0.00

3.2 Quantitative evaluation result of the

Green Office project

The data of the GO operation were evaluated according to the criteria given in Table 1. Results of the GO project operation were converted into an improvement compensation value. The total compensation

value obtained from the evaluation was 299.00 million Baht, which is 1.4 million Baht per office per year. On dividing the compensation into three dimensions, it was found that 262.5 million Baht was spent on economic compensation, 28.5 million Baht on social compensation, and only 7.55 million Baht was for environmental compensation. The detailed values are given in Table 7.

Table 7. Quantitative evaluation of the GO project (2015-2017)

No.	Category Activities	Results	Evaluation guidelines	Quantitative result	Unit	Compensation)Baht(		
						Economic	Social	Environmental
1	Information on GHG	Increased ability to evaluate GHG emissions of the office	To reduce GHG by calculating GHG quantity	207	person	--	1,035,000	--
2	Initiatives to publicize the staff	Increased awareness and participation of staff	To provide training and education for behavioral change of staff	54,980	person	--	27,490,473	--
3	Consumption of Water	Quantity of water consumption reduced	To save water and reduce the bill	640,247	m ³	17,606,786	--	--
4	Consumption of water	Quantity of water consumption reduced	To save water and reduce GHG emission	513	tCO ₂ e	--	--	15,377
5	Consumption of water	Quantity of water consumption reduced	To reduce water consumption	923,236	m ³	--	--	138,485
6	Consumption of energy	Quantity of energy consumption reduced	To reduce electricity bill	49,351,000	kWh	202,338,907	--	--
7	Consumption of energy	Quantity of energy consumption reduced	To reduce GHG emission from electrical appliance	30,100	tCO ₂ e	--	--	902,086
8	Consumption of energy	Quantity of fuel oil	To reduce fuel bill	503,000	Liter	12,855,696	--	--

No.	Category Activities	Results	Evaluation guidelines	Quantitative result	Unit	Compensation)Baht(		
						Economic	Social	Environmental
		consumption reduced						
9	Consumption of energy	Quantity of diesel oil consumption reduced	To reduce GHG emissions from fuel consumption	1,381	tCO ₂ e	--	--	41,419
10	Consumption of energy	Quantity of gasohol consumption reduced	To reduce expenses on fuel consumption	6,680	Liter	179,693	--	--

Source: Aroonsrimorakot et al. [30]

Table 7. Quantitative evaluation of the GO project (2015-2017)*Continued*

No.	Category Activities	Result	Evaluation guideline	Quantitative result	Unit	Compensation)Baht(		
						Economic	Social	Environmental
11	Consumption of energy	Quantity of gasohol and other fuel consumption reduced	To reduce GHG emissions from fuel consumption	15.2	tCO ₂ e	--	--	456
12	Consumption of paper	Quantity of paper consumption per unit reduced	To reduce paper consumption	558,617	Kg	26,813,656	--	--
13	Consumption of paper	Quantity of paper consumption per unit reduced	To reduce GHG emissions from paper consumption	2,913	tCO ₂ e	--	--	78,335
14	Consumption of paper	Quantity of paper consumption per unit reduced	To reduce GHG emissions	63.1	tCO ₂ e	--	--	1,893
15	Seminar, meeting, and other arrangement	Quantity of paper consumption for meeting reduced	Switched to Online meeting to reduce GHG emission	15.7	tCO ₂ e	--	--	472
16	Management of waste	Quantity of generated waste reduced, reused, and recycled	To reduce the cost of eliminating waste	413	ton	827,344	--	--
17	Management of waste	Quantity of recycled and reused products increased	Giving compensation for purchasing reused and recycled products	413	ton	1,861,525	--	--
18	Management of waste	The quantity of generated waste reduced	To reduce GHG emission by separating leftover food	195,200	tCO ₂ e	--	--	5,856,640
19	Management of office equipment	The source of air pollution in the office is not	To improve sanitation and reduce air	139.1	Machine/year	--	--	514,662

No.	Category Activities	Result	Evaluation guideline	Quantitative result	Unit	Compensation)Baht(		
						Economic	Social	Environmental
		due to usage of the office equipment	pollution by using air-purifier					
20	Procurement	Sustainable procurement increased	To reduce GHG emissions by purchasing eco-friendly products such as:	142.58	tCO ₂ e	--	--	4,277
			- paper	104	tCO ₂ e	--	--	3,125
			- envelope	15.5	tCO ₂ e	--	--	465
			- office file	3.14	tCO ₂ e	--	--	94
			- ink cartridge	19.2	tCO ₂ e	--	--	576
			- tissue paper	0.59	tCO ₂ e	--	--	18
Total						262,483,609	28,525,473	7,552,056

Source: Aroonsrimorakot et al. [30]

The analysis of the data from in-depth interviews revealed that each has at least one responsible person who took responsibility for the operation of the GO project. Also, every participating office formed a responsible committee, who were assigned responsibilities, criteria of auditing, and performance in meetings organized periodically. Each committee of an office has at least 10 members, and the average days to complete the certification process is 30 days per office. On analysis of Table 7, it was found that the total budget for the GO Project operation was 5.1 million baht per year, which was 15.3 million Baht in total for operating three years, that is, 2015, 2016, 2017, and the equivalent budget per office was 72,440 Baht. However, expenses for replacing old office items with new ones and other office materials were excluded from evaluation. The worthiness of the project was calculated as given in equation (1). The obtained value after calculation was 18.5, and the median value ranges from 15.6 to 22.6. Excluding electricity cost, the cost value was found to be decreased, and if the quantity of paper consumption increased, the amount of compensation also increased to 69.4 million Baht. The mean value of the GO budget was 3.54.

4. Summary and Conclusions

This study aimed to evaluate satisfaction with the continuity of green office

projects' performance and to present an evaluation of the Green Office projects in Thailand in terms of economic, social, and environmental activities. The GO Project has been operating continuously under the sponsorship of the Department of Environmental Quality Promotion, Thailand to promote sustainability in the daily office operations. The evaluation of the current research was undertaken for a period of three years, from 2015 to 2017. The total budget sanctioned for this project was 15.28 million Baht. The study evaluated the operation of twenty activities listed in Table 7, such as information on Greenhouse gas emissions, initiatives to publicize the office staff, consumption of water, consumption of energy, consumption of paper, management of waste, seminars, meetings, and other arrangements, procurement, etc. The operating budget of the GO project consisted of economic, social, and environmental costs. 89.0 percent of the total budget was for economic activities such as expenses on energy and other resources used directly and indirectly, while 9.0 percent of the budget was sanctioned for social activities, including training, seminars, meetings, etc., for sharing knowledge and developing awareness among the staff. Lastly, 2.0 percent of the GO budget was spent on environmental activities.

Regarding the satisfaction of the GO operation among operators, a high proportion of participants (86.30 percent) were satisfied with

the staff's knowledge, intelligence, and awareness of the operating steps of GO, followed by satisfaction that participation in the GO project has promoted staff's quality of work and life (80.82 percent), satisfaction on the evaluation result of the national GO auditors certifying offices (79.45 percent), and satisfaction that participation in the GO project led to behavioral changes of staff (76.71 percent). Similarly, on evaluation of the satisfaction of administrators in the green office project operation, most administrators were satisfied with the view that joining the GO project provided knowledge to their office about the GO operation procedure (90.41 percent), followed by the view that the GO project has awarded certificate trophies to offices based on auditing score (89.04 percent). Based on this satisfaction evaluation, it can be concluded that

- The majority of the participant administrators have high satisfaction with the view that the GO project provided knowledge to my office about the GO operation procedure (90.41%)
- The majority of the participant administrators have high satisfaction with the statement that the GO project has awarded certificate trophies to offices based on auditing score (89.04%)
- The majority of the participant administrators have high satisfaction with the statement that the GO project has provided a policy for continuous improvement of the office (84.93%)
- The majority of the participant operators have high satisfaction with the staff's knowledge, intelligence, and awareness of the operating steps of GO (86.30%)
- The majority of the participant operators have high satisfaction that participation in the GO project has promoted staff's quality of work and life (80.82 %)
- The majority of the participant operators have high satisfaction, which is based on the evaluated result, the national GO auditors certify offices as GO (79.45%)

- The majority of the participant operators have high satisfaction that when the evaluation is completed and finalized, qualified offices are listed, and then award trophies based on the result score (78.08 %)

On the evaluation of the GO project in Thailand in terms of economic, social, and environmental compensation, the result shows that the total compensation value obtained from the evaluation was 299.00 million Baht, which is 1.4 million Baht per office per year. On dividing the compensation into three dimensions, it was found that 262.5 million Baht was spent on economic compensation, 28.5 million Baht on social compensation, and only 7.55 million Baht was for environmental compensation. The above result also shows a massive reduction in the consumption of energy, paper, other office resources, and generated waste, which is an indirect outcome of each office's adoption of resource-saving measures, and these measures directly or indirectly cause an impact on sustainability on the economy, society, and the environment. In the end, it can be concluded that the result of the performance evaluation of the GO Project in Thailand reveals that participation in the GO Project brings satisfaction to offices in terms of economy, society, and the environment. Adoption of GO activities promotes sustainability through behavioral changes, which indirectly leads to the reduction of consumption of natural resources. On the whole, certifying an office with the Green Office Standard is essential to save resources for achieving a sustainable environment. Finally, the study suggested that the GO project should get support and approval as a national policy from the government in the years to come for the continual development of the GO Thailand standard at the international level.

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Community-Based Peace Education Framework for Sustainable and Transformative Peacebuilding

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Abstract

The study explores the gap between Western peace education, which emphasizes universal principles such as human rights, democracy, and non-violent conflict resolution, and the cultural realities of the Philippines, where these models often do not resonate. Western peace education approaches are based on the premise of universal values and methods, which may not align with the unique cultural, social, and historical contexts of non-Western societies. Through a systematic review of both international and local literature, this paper highlights the necessity for peace education to be culturally sensitive and contextually relevant. The study introduces a Contextualized Peace Education Framework that is specifically tailored to Filipino values and societal norms, incorporating indigenous knowledge, community-driven solutions, and non-intrusive conflict resolution techniques. This framework emphasizes transformative education that fosters empowerment, integrates local histories, and respects the cultural importance of privacy in conflict resolution, providing a more appropriate and effective approach. The findings underscore the need for peace education to be adapted to local contexts, where a one-size-fits-all approach proves to be ineffective. This context-specific approach not only encourages social responsibility and sustainable peace but also promotes critical thinking towards sustainable peace and stronger community cohesion in the Philippine context.

Keywords: Community-Based, Peace Education Framework, Transformative, Sustainable Peace

Article history: 5 March 2026, Revised 20 April 2026, Accepted 29 April 2026

Introduction

The UNESCO Constitution states, “Since wars begin in the minds of men, it is in the minds of men that the defense must be constructed,” underscoring the role of education in fostering a culture of peace. This recognized peace education as an essential approach to fostering understanding, cooperation, and conflict resolution in both local and global contexts. The goal of peace education is to cultivate a culture of peace by addressing the root causes of violence and promoting non-violent alternatives. Peace education teaches individuals and communities how to resolve conflicts peacefully, understand human rights, and embrace diversity, while also emphasizing

the importance of social justice and environmental sustainability [1].

However, much of the peace education frameworks developed and implemented globally have been influenced by Western models, which, while influential, may not always be directly suited to local conflict dynamics. Western peace education tends to emphasize universal values and approaches that may not fully align with the unique historical, cultural, and socio-political contexts of different regions [2]. The adoption of such frameworks in regions with distinct forms of violence, such as structural violence or ethno-political conflict, often leads to a gap in effectiveness [3]. This misalignment calls for a more contextualized approach to peace

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education, one that is deeply rooted in the local experiences, values, and realities of the community it serves. By adapting peace education to address the specific conflicts and challenges faced by local communities, more relevant and impactful outcomes can be achieved, fostering sustainable peace on the community level [4].

Peace education frameworks have traditionally been shaped by Western scholarship and international agencies, emphasizing universal values such as human rights, democracy, and nonviolence. Foundational texts like *Peace Education: The Concept, Principles, and Practices Around the World* demonstrate how these approaches have been articulated in literature [5]. Betty Reardon's *Education for a Culture of Peace in a Gender Perspective* further situates peace education within broader global initiatives, while highlighting the integration of social justice, gender equality, and intercultural understanding in educational practice [6]. However, these frameworks often reflect Western academic priorities and may not fully engage with local narratives of structural violence or community based conflict resolution. This gap underscores the need for contextualized peace education that draws from grassroots experiences while building on established theoretical foundations.

The current global crisis

The current global crisis was a result of existing structural violence in the society. The ongoing global crisis is a consequence of entrenched structural violence within society. Unjust government policies and systems have prioritized personal interests over the well-being of the people. The widespread human suffering, death, and harm, while cultural violence involves societal norms and practices that perpetuate discrimination, injustice, and inequality [8]. These forms of violence are not isolated to specific regions but represent a global crisis, manifesting in various forms of social, economic, and political oppression

worldwide. Brantmeier [9] emphasized the importance of peace education, incorporating a critical analysis of power dynamics in the context of place, particularly in efforts aimed at achieving social and environmental sustainability. Instead of merely reinforcing the status quo, peace education for sustainability should aim to reveal and challenge the power structures that underpin both structural and cultural violence. In addition, The researcher explains the significance of a peace education as a conscious effort to teach both children and adults about the complexities and realities of peace and violence in the local context [7].

The study by Floro [10] developed a peace education framework that is not based on Western models but instead tailored to the needs of the local community. This framework was contextualized by incorporating the narratives of grassroots communities about the structural violence they experience. It also included non-violent conflict resolution strategies aimed at addressing local conflicts, ensuring the approach was both relevant and effective within the specific context of the community. The context-specific concept, human security acknowledges that insecurities vary considerably across different settings and as such advances contextualized solutions that are responsive to the particular situations they seek to address. Finally, in addressing risks and root causes of insecurities, human security is prevention-oriented and introduces a dual focus on protection and empowerment. Ardizzone [11] argues that peace education has long focused on safeguarding human rights, emphasizing that issues such as deprivation, discrimination, and social injustice have become normalized. This underscores the critical need for educational approaches that bring about transformation. Peace education has always focused on identifying the underlying causes of various forms of violence and working towards their elimination.

Central to this approach are the values of democracy, human rights, and peace, which are

essential to both the practice and objectives of education. Peace education equips learners with the knowledge, skills, and values needed to resolve conflicts nonviolently and promote social justice, human dignity, cultural diversity, and environmental responsibility. Harris et.al. [12] As defined by UNICEF, it develops behaviors and competencies that prevent violence and support peaceful relationships at all levels. In the Philippines, the limitations of generalized and Western-based peace education models have led to the development of a contextualized framework. Ongoing challenges, including stalled peace processes involving the CPP-NPA-NDFP, highlight the need for approaches grounded in local realities. Contextualized peace education responds by aligning content with the political, economic, and sociocultural conditions of specific communities.

This study proposes a contextualized peace education framework tailored to the local context of Bataan. It does not reject existing theories but adapts them to better address local conflicts and experiences. By integrating community perspectives, the framework enables learners to understand the root causes of violence and develop nonviolent, culturally relevant solutions. Inspired by the ideas of Maria Montessori, the framework emphasizes education as a pathway to peace. It adopts a learner-centered approach that actively involves students in peacebuilding, strengthens critical thinking, and empowers them to become responsible citizens committed to promoting a culture of peace.

Transformative Education

The contextualized peace education framework is a form of transformative education because of its primary objective to inculcate a culture of peace among learners through teaching significant peace values that support and sustain peacebuilding in the school and community [13]. It seeks to change the mindset and behavior of individuals from the

tendency of violent conflict resolution to cultivating skills, knowledge, and attitudes that support and promote peacebuilding by resolving conflicts through peaceful means. According to the UN Secretary-General, education should provide people with the knowledge, skills, and values they need to take part in resolving the interconnected challenges of the 21st century [14]. The contextualized peace education framework presents a local perspective and offers an education that potentially leads to individual and social transformation through the different domains of the contextualized peace education framework, such as empowerment and social action through human rights education, dismantling discrimination and prejudice through promoting understanding and tolerance, ecological preservation and just distribution of the earth's resources, understanding direct and structural violence in the community, historical analysis of local conflicts and violence, nurturing inner and structural peace, resolving conflicts through peaceful resolution, reconciling different beliefs and ideologies, and the development of school-community peace programs [13]. This means that the contextualized peace education framework invites learners into the teaching-learning process that is progressive and enlightened, enabling them to understand the underlying root causes of conflict in their locality or community. In addition, learners will be sensitized regarding the direct and structural or hidden violence that has become normalized in their daily lives. The knowledge gained will serve as the foundation for transforming mindsets, attitudes, and behaviors to make constructive solutions based on the principle of peace education. The learning process on contextualized peace education will lead to social action toward the transformation of society, which includes becoming an agent of peace, a human rights defender, and a mediator for non-violent conflict resolution [15].

Ecological Preservation and Just Distribution of Resources

Ecological preservation is essential for achieving peace, as it fosters a sustainable relationship between humans and the environment. In an era marked by significant ecological disruption, understanding and enhancing ecological integrity is crucial. Currently, our world is facing numerous ecological problems, such as air pollution, water, and soil contamination brought by industrialization and economic development. Under the domain of ecological preservation, students will be able to understand the impact of environmental degradation, such as global warming, on the violation of human rights. Global warming, deforestation, pollution, and other ecological issues are not merely environmental problems but rather are fundamentally human rights crises. The adverse effects of climate change disproportionately impact vulnerable populations, exacerbating existing inequalities and threatening fundamental human rights [16]. It is important to incorporate environmental education into a contextualized peace education framework. The integration of ecological preservation into the contextualized peace education framework ensures that students clearly understand the significant effect of the environment on the basic right of an individual to food, health, and a healthy environment. In addition, students will be able to understand that calamities brought by climate change affect the basic human rights of individuals to life, property, and dignity. Global warming also impedes our rights to access good health and security. The continuous degradation of the environment increases temperature, causes unpredictable weather, and results in super typhoons that cause damage to property, community, displacement, and loss of lives (Rolnik, 2009). It is important to recognize that peace education, human rights, and the environment are interconnected; the human rights of an individual cannot be fully maximized or

enjoyed without a safe, clean, and healthy environment, and the role of peace education equips our learners with knowledge and skills to defend and assert their basic rights and protect the earth by peaceful means."

Understanding Direct and Structural Violence

Understanding direct and structural violence is significant to the contextualized peace education framework because it tends to reveal the visible and invisible types of violence embedded in societal structures. The goal of peace education is to expose hidden oppression and injustices such as uneven resource distribution, lack of political will, government transparency and corruption, ineffective justice system, stalled economic programs and development, poverty and hunger, and the destruction of cultural heritage and IP communities. Galtung [3] explained that the manifestation of structural acts of violence is the highly uneven distribution of wealth and the unequal distribution of power over the distribution of resources. The structural violence strand of the peace education framework emphasizes a concrete understanding of the historical, sociopolitical, socioeconomic, and sociocultural underlying forces that shape inequity, suffering, and injustice in society. It also intends to highlight the marginalization of classes, genders, and social hierarchy. Furthermore, structural violence in the CPE framework might help explain the hidden and complex mechanisms that maintain inequality at various levels. The strand of structural violence also emphasized the historical roots of class struggle, colonialism, and imperialism as the causes

of modern injustices and inequality [10]. The root cause of violence can only be revealed through a critical analysis of the social context and a thorough examination of the lengthy history of institutional violence. The contextualized peace education framework will provide a crucial context for understanding the

underlying structural violence and its relationship to the continuous violence and insurgency in the country.

Historical Analysis of Local Conflicts

Historical analysis of local conflicts is essential in contextualized peace education because it sheds light on the underlying root cause of societal problems and issues by examining past conflicts, students will be able to identify patterns, motivations, and consequences that inform present-day issues. Bergman [17] stated that understanding how students perceive historical significance can illuminate how they connect past events to current realities. This connection is important for developing learners' critical thinking skills that empower them to analyze existing conflict by utilizing a historical lens. One of the major objectives of contextualized peace education is for students to have historical awareness of their locality and to avoid the same mistakes that have been previously committed or made. In addition, historical analysis of conflicts capacitates our learners to be aware of the consequences of the root cause of conflicts. Also, it is expected that they were able to develop a way of thinking for creating peaceful solutions to problems as well as fostering attitudes that value peace and critical thinking. This is significant in teaching and learning because considering history in the CPE, students will be able to recognize the injustices, struggles, and violence that were fought in the past, so it will not be repeated in the future. Susanto [19] mentioned that the goal of history is to mold our learners to equip them with better personal characteristics, attitudes, and values supporting the value of unity, oneness, and peace, and avoiding conflict and violence amid our differences in opposite beliefs and perceptions.

Nurturing Inner and Structural Peace

A key domain of contextualized peace education is the cultivation of inner peace, understood as a sense of harmony within oneself and in relation to others. Participants associated peace with positive relationships, self-respect, human dignity, and freedom from fear and insecurity. Inner peace enables individuals to respond to conflict constructively and maintain a positive outlook despite challenges. Peace education aims to promote both personal and social transformation. It strengthens values such as tolerance, empathy, respect, and social responsibility, which are essential for nonviolent conflict resolution. Inner peace serves as the foundation for building healthy relationships and reduces the likelihood of resorting to violence. Nario-Galace [19] It also fosters awareness of social realities, linking personal transformation to broader societal change. Inner peace is closely connected to structural peace, or "positive peace," [20]. Positive peace goes beyond the absence of war and emphasizes the presence of social justice, equality, human rights, and equitable resource distribution. Achieving structural peace requires conditions such as good governance, social equity, cultural tolerance, and access to basic services. The framework highlights key indicators of structural peace, including respect for human rights, reconciliation,

Resolving Conflict through Non-Violent Resolution

Contextualized Peace Education aims to develop learners' skills, knowledge, and attitudes to address occurring conflicts and resolve conflicts peacefully. on-violence conflict resolution is crucial in fostering a culture of peace, particularly within educational settings. Johnson and Johnson, (2014) mentioned the distinction between imposed peace achieved through coercion and consensual peace, which is rooted in mutual understanding and cooperation. By integrating

conflict resolution strategies into educational curricula, we can cultivate environments where students learn to navigate disputes constructively rather than resort to violence. This focus on non-violent methods not only addresses immediate conflicts but also contributes to long-term relational harmony. Contextualized peace education is a type of education that dwells in the value of cooperation, respect, tolerance, justice, and nonviolent conflict resolution. In addition, it is important that in the teaching-learning process, students can be confronted with the truth by raising significant facts about societal issues and providing alternative solutions that uphold social justice, peace, and reconciliation. Webb et al. [20] mentioned social reconstructionism in education as having a significant role in encouraging students to be “agents of change” by challenging the norms and injustices to make society a better place for everyone. In the CPE students were asked to look for social injustices and inequalities in their community and try to look for alternative nonviolent solutions to address the particular issues [21]. Reconstructive-Empowering approach underscores the necessity of promoting critical thinking and ethical development within peace education frameworks. This method encourages students to envision creative solutions that transcend traditional violent responses to conflict. Ultimately, embracing non-violent conflict resolution through comprehensive peace education can lead to transformative societal changes that prioritize collaboration over confrontation.

Empowerment and Social Action through Human Rights Education

Human Rights Education is one of the core values of contextualized peace education because it seeks to uphold human dignity. In contextualized peace education, the primary concern of learning is to promote and uphold human dignity and the well-being of an individual because that is the very foundation of peace. Human Rights Education (HRE) is an

essential component of contextualized peace education that empowers students to understand and advocate for their rights and the rights of others. Integrating HRE into school curricula not only fosters a culture of respect and tolerance but also equips students with the critical skills needed to recognize and address human rights violations in their lives and communities [23]. In a community in which discrimination, prejudice, violence, and injustices are present in the structure of society, integrating human rights education, students will be able to understand and take necessary action against these challenges by cultivating individuals capable of engaging in constructive dialogue and peaceful solutions. Navarro-Castro and Nario-Galace [19] stated the impact of human rights education towards addressing nonviolent social order and reducing the causes of armed conflict. Inculcating human rights education in the curriculum is essential for fostering a culture of peace, tolerance, and understanding among the diversity in their respective communities. In addition, human rights education empowers our learners to engage in social issues and problems critically and equips them with the set of skills that is needed to challenge human rights violations and injustices in the locality. By integrating human rights education into the curriculum, we educators could develop citizens who advocate, uphold, and defend their rights and the rights of others.

Reconciling Diverse and Contrasting Ideologies and Beliefs

Throughout the history of mankind, our political, economic, psychological, and sociocultural orientation and world views have been guided by ideological beliefs, norms, ideas, and philosophies that are commonly associated with power relations. There is a period in our history when two great political-economy ideologies, which are communism and capitalism, seek to assert their dominance in shaping political and economic structures globally. The contradiction of ideologies

marked significant events in our history, like the Cold War, the Fall of the Berlin Wall, and the insurgency of the CPP-NPA in the Philippines, which is identified as the longest-withstanding armed conflict in Asia. In contextualized peace education, understanding the contrasting beliefs and ideologies is a significant part of teaching a culture of peace among the students. Reconciling opposite views and beliefs through peace education is essential for fostering understanding in increasingly diverse societies. The implementation of a comprehensive peace education curriculum. Contextualized peace education aims to motivate the reconciliation of contradictions among ideologies and beliefs of diverse groups of people through intercultural dialogue, mediation, and positive communication, which aim to break barriers and misunderstandings. The goal of intercultural dialogue and reconciliation is to instill values such as respect for differences and national identity, which are foundational for peaceful coexistence. By emphasizing knowledge over mere skill development, this approach aligns with the United Nations' goal of promoting a culture of peace through education. Contextualized peace education is more focused on understanding the contradiction among ideologies and beliefs that cause conflict and violence and actively participating in resolving such conflicts rather than merely absorbing theoretical concepts.

Challenging Discrimination and Prejudice by Promoting Understanding and Tolerance

Discrimination and prejudice remain major sources of conflict and violence in contemporary society. Contextualized Peace Education (CPE) addresses these issues by challenging biases against Indigenous peoples, LGBTQ+ individuals, and other cultural groups. A key component of the framework is dismantling stereotypes through experiential learning that exposes students to diverse perspectives and histories. This helps break notions of cultural superiority based on

appearance, identity, or background. CPE promotes core peace values understanding, tolerance, and empathy by encouraging respect for diversity and recognition of individual differences. According to UNESCO, teaching tolerance enables learners to respect and appreciate cultural diversity and human expression. Empathy further strengthens this by helping students relate to others' experiences and perspectives. Through critical engagement with issues of discrimination, peace education fosters inclusive mindsets and supports the development of more equitable and harmonious communities.

Development of School-Community Localized Peace Partnership Programs

School-community partnerships play a vital role in promoting a culture of peace. By integrating formal education with community-based learning, schools can serve as active agents of peacebuilding. Collaboration among educators, local stakeholders, and communities strengthens relationships and enriches learning experiences grounded in real-world contexts. The Contextualized Peace Education Framework (CPEF) in Bataan aligns curriculum content, teaching materials, and learning strategies with the province's sociocultural, political, and historical realities. This ensures that education is relevant, culturally responsive, and focused on local peace and conflict issues. It also promotes critical thinking by integrating topics such as human rights, social justice, and conflict resolution into the curriculum. CPEF supports local peacebuilding by enabling deeper analysis of the root causes of conflict beyond generalized national approaches. Through strong school-community collaboration and localized programming, it contributes to sustainable peace, social cohesion, and community development.

Contextualized Peace Education

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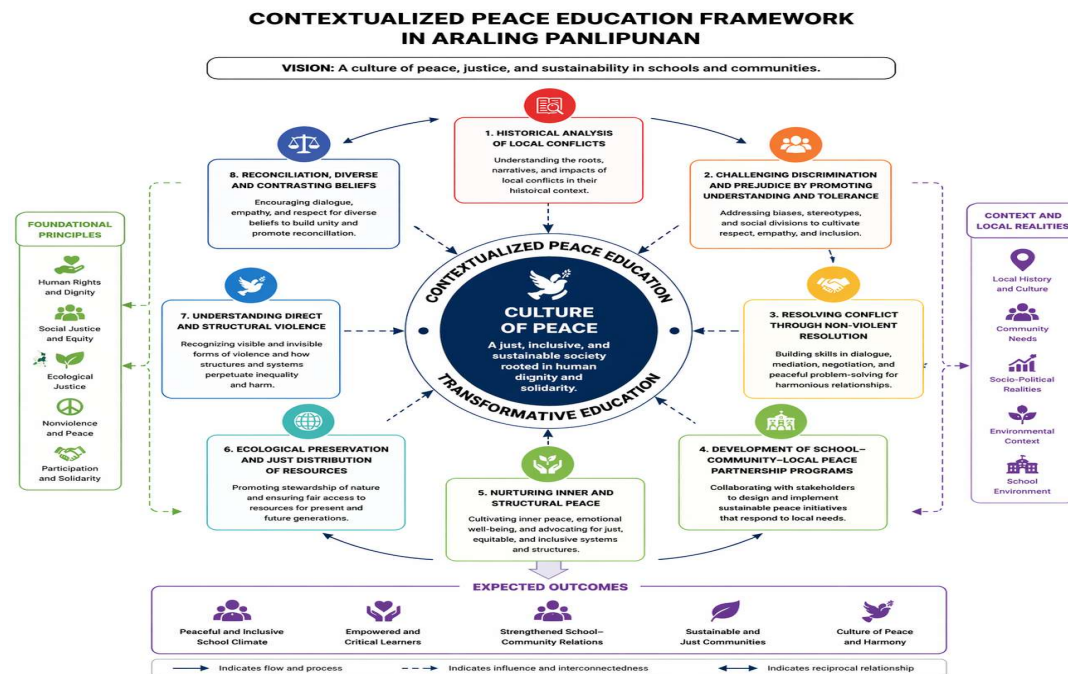


Figure 1. Elements of the Green Office Management System

Conclusion

The study highlights the significance of Contextualizing Peace Education (CPE), which is grounded in the sociocultural, political, economic, and historical realities of local contexts, as it is crucial for promoting transformative and sustainable peace. Unlike Western peace education, the contextualized peace education framework directly addresses the particular challenges and conflict dynamics

of the community that are exemplified in the province of Bataan. The CPEF framework empowers learners to critically analyze and understand the existing direct and structural violence, contextual historical conflicts, and the socio-environmental impacts affecting peace. The core of this framework is the learner-centered transformative pedagogy that nurtures values of human rights, social justice, tolerance, empathy, and ecological preservation. The learners primarily acquire valuable peace

values, knowledge, and skills that are essential for nonviolent conflict resolution, intercultural dialogue, and social action. In addition, the CPEF recognizes the link between the inner peace of an individual and structural peace in society, which highlights the notion that peace is not merely the absence of war or direct violence but the presence of positive peace that emanates from the existence of justice, equity, and human dignity in society's structures. Through capacitating teachers with peace knowledge that is grounded on CPE, it empowers them as agents of peace and fosters strong school-community partnerships, ensuring that peace education is locally relevant, culturally embedded, and institutionally supported. Incorporating indigenous knowledge systems and community-based peace practices further enriches the educational process.

Finally, the contextualized peace education framework aims to develop learners who are responsible, critical, and engaged citizens capable of fostering inclusive social transformation and sustainable peace. This comprehensive approach holds promise not only for educational institutions in conflict-affected settings but also as a model for peacebuilding that is adaptive, participatory, and culturally resonant, helping break cycles of violence and nurturing cultures of peace within local and broader communities.

Acknowledgement

I would like to express my deepest gratitude to my beloved wife Leigh, whose unwavering love, support, and inspiration have been the cornerstone of this paper. This paper is a testament to her enduring strength and the profound impact she has had on my academic journey and personal growth

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Effect of Emulgel containing Langkasuka Oil versus Diclofenac Gel for Improving Physical Function in Patients with Knee Osteoarthritis: A randomized controlled trial

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Abstract

Knee osteoarthritis (KOA) is characterized by a progressive decline in physical functioning. Emulgel containing Langkasuka oil (ELO) represents a newly developed formulation incorporating Langkasuka oil (LO) as an active constituent. This study aimed to evaluate the impact of ELO on lower limb function and mobility, as assessed by the Timed Up and Go (TUG) test and 30-Second Chair Stand (30-CST) test. A randomized controlled trial was performed between July 2025 and February 2026. A total of 62 participants were randomly allocated into two groups of 31 each: an experimental group receiving topical ELO and a control group receiving topical diclofenac gel (DG). Both groups were instructed to apply the assigned substance to the knee area three times daily for a period of four weeks. Outcome measures were assessed at baseline, day 14, and day 28. Statistical analysis was performed using repeated measures ANOVA to assess within-group changes over time, and one-way ANOVA to examine between-group differences. The results of the ELO group showed a progressive decline in mean scores from 11.29 ± 1.42 at baseline to 8.10 ± 0.94 at Day 28, indicating a clinically significant transition from moderate fall risk to normal functional status. A comparable reduction was observed in the DG group, with mean scores decreasing from 11.26 ± 1.55 at baseline to 8.06 ± 1.12 at Day 28. Both the ELO and DG groups demonstrated statistically significant improvements in 30-CST performance over the 28-day intervention period ($p < 0.001$), with mean scores increasing from 8.61 ± 1.05 to 10.26 ± 1.29 and from 8.65 ± 0.98 to 10.13 ± 1.26 , respectively. In conclusion, ELO demonstrated physical performance improvements comparable to those observed with DG, suggesting its potential as an alternative topical therapeutic option for the management of KOA.

Keywords: Knee osteoarthritis, Emulgel, Langkasuka Oil, Physical function, Diclofenac gel

Article history: Received 28 April 2026, Revised 30 April 2026, Accepted 30 April 2026

1. Introduction

Knee osteoarthritis (KOA) ranks among the most prevalent musculoskeletal conditions worldwide and has been the most extensively investigated joint disorder with respect to disease frequency [1]. Prevalence estimates vary considerably across geographic

regions, with approximately 17% of adults aged ≥ 45 years affected in the United States [2], 14.6% in China [3], and 4.0–59.4% among Thai adults aged ≥ 45 years, with variability attributed to differences in diagnostic criteria and study populations [4]. Well-established risk factors include advancing age, female sex, obesity, prior knee injury, family history of

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osteoarthritis, and occupational physical loading [5]. Disease progression in KOA is characterized by chronic pain, progressive impairment of physical function, and reduced participation in occupational, social, and recreational activities, collectively contributing to diminished health-related quality of life [7]. Current evidence-based management guidelines for KOA prioritize three therapeutic objectives: pain alleviation, restoration of physical function, and attenuation of disease progression. Among pharmacological strategies, nonsteroidal anti-inflammatory drugs (NSAIDs) are recommended as the cornerstone of first-line treatment [6]. Topical diclofenac gel exerts its therapeutic effects by penetrating the skin and diffusing into deeper periarticular tissues, including the synovial membrane, thereby enabling direct pharmacological action at the site of pain and inflammation. Its principal mechanism of action involves selective inhibition of cyclooxygenase-2 (COX-2), reflected by a COX-1/COX-2 IC₅₀ ratio of 29 [8], which suppresses the conversion of arachidonic acid into pro-inflammatory prostaglandins and attenuates local inflammatory activity at the affected joint [9,10]. Despite being a recommended first-line therapeutic option for KOA, topical nonsteroidal anti-inflammatory drugs (NSAIDs) are not without limitations, as their use has been associated with localized cutaneous reactions and transient mild adverse effects [11]. There is therefore a compelling need to explore plant-derived products as alternative therapeutic options for the management of KOA.

Langkasuka Oil (LO) is a traditional herbal massage oil composed of a blend of medicinal plant extracts, formulated by integrating the traditional healing knowledge of local midwives (Tok Bidae) with Thai massage principles [12]. LO comprises nine medicinal plants: *Tacca leotopetaloides*, *Zingiber montanum*, *Curcuma longa*, *Pandanus amaryllifolius*, *Salacia chinensis*, *Citrus hystrix*, *Cymbopogon citratus*, *Nigella sativa*,

and *Piper nigrum* [13]. The predominant component, Phlai (*Zingiber montanum*) rhizome, contains diverse secondary metabolites including phenylbutenoids and their dimers which exhibit significant anti-inflammatory properties [14]. Chemical analysis of coconut oil-fried Phlai further identified compound-D and related cassumunoids with notable anti-inflammatory activity in animal models, with a minimum effective concentration of 25% required for therapeutic efficacy [15]. Turmeric (*Curcuma longa*), another key constituent, contains curcumin a lipophilic polyphenol with well-documented antioxidant, anti-inflammatory, and antineoplastic activities relevant to cancer, autoimmune, neurological, cardiovascular, and metabolic conditions [16]. It has been used therapeutically to relieve musculoskeletal pain, improve muscle function, and enhance blood circulation, with particular benefits for elderly patients with knee pain and no reported contraindications [13]. A clinical study demonstrated that self-massage using LO applied bilaterally to the neck and shoulder muscles over 7 days significantly reduced pain intensity and improved cervical range of motion in all six directions among patients with office syndrome [17]. Based on the systematic review by Dobson et al. [18], the Timed Up and Go (TUG) test and the 30-second chair stand test have been established as the most well-supported performance-based measures for assessing physical function in individuals with hip and knee OA, underscoring their value as reliable and clinically relevant tools for functional evaluation in this patient population. However, studies examining the impact of ELO on physical function among patients with OAK are limited. this study aimed to evaluate its impact on lower limb function and mobility, as measured by the TUG test and 30-CST test. It was hypothesized that ELO intervention would result in comparable improvements in both outcomes relative to the DG group.

2. Methodology

2.1 Research design

This study was approved by the Human Research Ethics Committee of Phetchaburi Rajabhat University, it was conducted in accordance with the Helsinki Declaration no. 11/2025. The study was carried out at a subdistrict health promotion hospital in Amphoe Mueang from July 2025 to February 2026. Participant allocation was conducted via a randomized complete block design (RCBD), stratified by knee pain severity. A double-blind procedure was implemented, ensuring that neither the participants nor the investigators had knowledge of group assignments during the study. The diclofenac gel (DG) container was modified to match the green color of ELO, rendering the two preparations visually indistinguishable and thereby maintaining the integrity of the double-blind study design.

2.2 Drug preparation

The LO extraction was conducted in two sequential steps. The first step involved heating *T. leontopetaloides*, *C. citratus*, and *C. hystrix* peel in palm oil, followed by filtration. The second step began with heating *Z. montanum* and *C. longa* in palm oil in Traditional clay pot container over low heat. This base was then enriched with *S. chinensis*, *T. leontopetaloides*, *C. citratus*, *C. hystrix* peel, *P. amaryllifolius* leaves, and powdered *N. sativa* and *Piper nigrum*. After 6-12 hours of gentle simmering, the mixture was allowed to cool overnight for complete infusion. Subsequently, medicated oil, dissolved camphor-menthol mixture, and massage oil were added to the preparation and heated until thoroughly combined [13]. The ELO was prepared at the Faculty of Integrative Medicine, Rajamangala University of Technology Thanyaburi.

2.3 Sample size and patient's characteristic

Sample size was calculated using G*Power version 3.1.9.4, based on an effect size of 0.80 derived from pain intensity variance reported in a previous study of similar

design [19], with a significance level of 0.05 and a power of 0.90. An additional 10% was added to account for anticipated dropout, resulting in a required sample of 31 participants per group. Eligible participants included both males and females aged 50–80 years, with a primary knee osteoarthritis diagnosis confirmed by an orthopedic physician in accordance with the American College of Rheumatology clinical criteria and Kellgren-Lawrence radiographic grading of 1–3. Participants were excluded if they presented with any of the following: open knee wounds, planned knee arthroplasty within three months, known allergy to herbal preparations or alcohol, pregnancy or lactation, gout, pseudogout, rheumatoid arthritis, recent knee injury, paralysis, or Parkinson's disease. Additional exclusion criteria encompassed concurrent use of topical medications on the knee, use of NSAIDs or other knee osteoarthritis-related treatments including physiotherapy, knee massage, or acupuncture within the preceding 7 days, intra-articular injection of corticosteroid or hyaluronate within the past 3 months, use drugs such as glucosamine, diacerein, or chondroitin within the past 4 months. Should no allergic reaction be observed, the investigator provided a structured demonstration of the correct application method, after which participants were guided through hands-on practice as outlined in the research manual. Following baseline assessment of pain intensity using the Visual Analogue Scale (VAS) and physical function parameters, participants were assigned to either the experimental group, which applied Langkasuka Oil emulgel, or the control group, which applied diclofenac gel. Both groups received standardized training on proper product application and were instructed to apply the assigned intervention to the knee area three times daily morning, noon, and evening for four consecutive weeks. Compliance and symptom monitoring were facilitated through a daily self-reported diary maintained by each participant throughout the study period.

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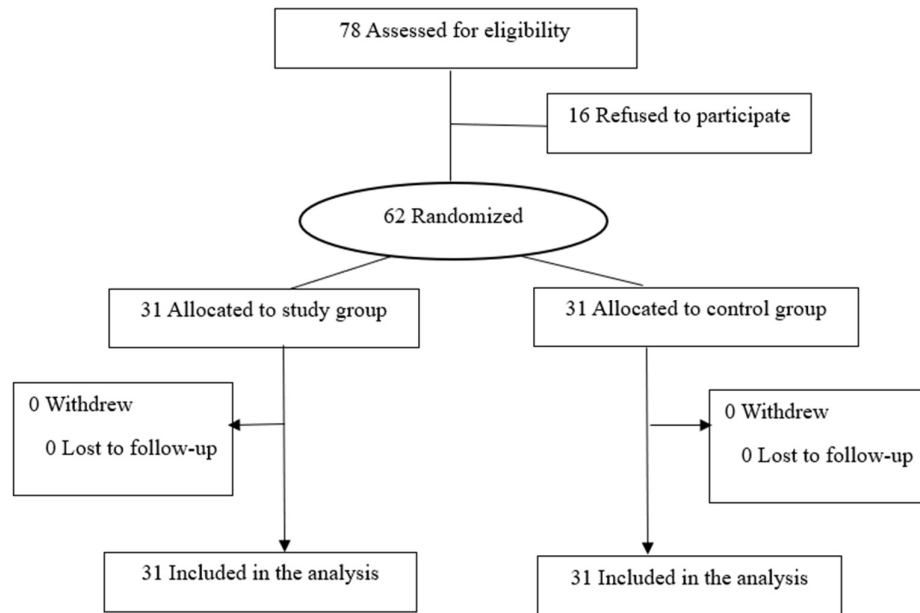


Figure 1. Flowchart of study

2.4 Outcome measurement

The TUG test was utilized to evaluate functional mobility and fall risk in all participants, with assessments consistently performed using a standardized chair with armrests. Each participant was instructed to rise from the seated position, with armrest assistance permissible if required, walk toward a line placed 3 meters away, turn, and return to sit in the chair. The recorded time began when the participant's buttocks lifted from the chair and ended upon their return to the seated position [20]. The 30-CST was conducted on a standardized armless folding chair with a seat height of 43.2 cm (17 inches). Participants were seated upright, with feet flat on the floor

at shoulder-width apart and arms crossed at the wrists against the chest. One to two practice trials were provided prior to formal testing, and any participant requiring arm support to stand was assigned a score of zero. Upon the start signal, participants alternated between a fully erect standing position and complete seated contact with the chair, aiming to complete the maximum number of stand-to-sit cycles within 30 seconds. The total number of fully completed stands constituted the final score [21].

2.5 Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 24.0 (IBM

Co., Armonk, NY, USA). In this study [22], within-group differences across successive time points were analyzed using repeated measures ANOVA, while between-group comparisons were performed using one-way ANOVA. Statistical significance was defined as a *p*-value of less than 0.05.

3. Results and Discussion

Sixty-two participants were enrolled and equally randomized into two groups, all of whom successfully completed the study as shown in Figure 1. The sample was predominantly female, representing 80% of the total population, with a mean age of 62 years and above. Mean BMI values ranged between 25 -26 kg/m², placing the majority of participants within the overweight classification.

Table 1. Physical function parameters within and between groups cut off at baseline, day 14 and day 28.

Measure	Baseline (mean±SD)	Day14 (mean±SD)	Day28 (mean±SD)	^a <i>p</i> -value
TUG				
ELO group	11.29±1.42	9.61±1.05	8.10±0.94	<0.001*
DG group	11.26±1.55	9.65±1.28	8.06±1.12	<0.001*
^b <i>p</i> -value	0.932	0.914	0.903	
30-CST				
ELO group	8.61±1.05	9.32±1.08	10.26±1.29	<0.001*
DG group	8.65±0.98	9.35±1.11	10.13±1.26	<0.001*
^b <i>p</i> -value	0.901	0.908	0.692	

^a*p*-value is calculated by repeated measure ANOVA test to determine differences within groups in different periods.

^b*p*-value is calculated by ANOVA for comparison between group.

**p*<0.001: statistically significant differences.

The TUG test measures mobility and dynamic balance, whereby a reduced completion time indicates superior physical dexterity and functional ability [23]. The threshold values used to assess fall risk have varied considerably across the literature, with older studies reporting a range of 10 to 33 seconds [24], whereas more recent investigations suggest a narrower range of 8.1 to 16 seconds [25]. Results are interpreted as follows: completing the test in 10 seconds or under is regarded as normal, a completion time ranging from 11 to 20 seconds reflects a moderate fall risk, while a time of more than 20 seconds is indicative of a high risk of falling [26]. In both groups, TUG parameters showed statistically significant reductions following 28 days of intervention (*p*<0.001) (Table 1). In the ELO group, mean scores declined from 11.29±1.42 at baseline to 8.10±0.94 at Day 28, representing a shift from

moderate fall risk to normal. Similarly, the DG group demonstrated a reduction from 11.26±1.55 at baseline to 8.06±1.12 at Day 28, also transitioning from moderate fall risk to the normal range. These results indicate that both treatments successfully enhanced mobility and lowered the risk of falling among study participants, which is in line with previously reported evidence on the use of Ya pok Dud pid, where a decline in TUG scores to 8.20±1.22 was observed at the 42-day follow-up assessment [27].

The 30 CST was applied as an assessment of lower limb muscle strength, capturing the number of chair stand repetitions an individual could complete within a 30-second interval [28]. For individuals aged below 80 years, a score of approximately 10 points is considered within the normal range [26]. Both the ELO and DG groups exhibited statistically significant improvements in 30

CST performance following 28 days of intervention ($p < 0.001$), with mean scores rising from 8.61 ± 1.05 to 10.26 ± 1.29 and from 8.65 ± 0.98 to 10.13 ± 1.26 , respectively. Notably, participants in both groups progressed from below-normal values at baseline to within the normal range of approximately 10 repetitions by the end of the study period, highlighting the equivalent effectiveness of both treatments in enhancing lower limb muscle strength among the study participants.

The improvement in physical function observed among patients with knee osteoarthritis may be attributable to the bioactive constituents of ELO, particularly *Nigella sativa*, which serves as a principal component of the formulation. Thymoquinone, considered one of the primary active constituents of *N. sativa* extract, has been shown to possess analgesic properties, making it a potentially valuable agent in the management of pain and inflammatory conditions [29]. Furthermore, previous research has demonstrated that topical administration of *N. sativa* oil over a 21-day treatment period produced greater analgesic benefits in of life in patients with upper trapezius myofascial pain syndrome comparison to diclofenac gel [30]. Phlai, a key constituent of ELO, has been reported to alleviate pain, improve range of motion, and enhance quality of life [31].

KOA related activity limitations have been shown to impair social participation and mental health outcomes, thereby leading to a marked reduction in the overall quality of life (QoL) experienced by affected individuals [32]. QoL can be measured using two principal approaches: 1) a generic instrument that captures the broad influence of disease on a patient's overall health status, 2) a disease-specific instrument that exclusively assesses the effect of the condition on those QoL domains most directly implicated by the disease itself. An increasing number of studies have suggested that the deterioration of QoL observed in individuals with knee osteoarthritis may result directly from diminished physical

mobility, worsening pain experience, imbalanced musculature, and an overall reduction in functional capacity [33]. A study conducted among older adults with knee osteoarthritis in India demonstrated consistently poor scores across all physical health-related quality of life domains, including physical functioning (PF), role limitation attributable to physical health (RP), bodily pain (BP), energy and vitality (VT), general health perception (GH), and perceived health transition [34]. Similarly, the researcher reported statistically significant impairment across all QoL subscales, with the exception of the role emotional and general health (GH) domains [35].

There were several limitations to this study. First, physical health-related quality of life domains were not assessed, which may have limited a comprehensive evaluation of the intervention's overall impact on patient well-being. Second, the follow-up duration was restricted to 28 days, which may be insufficient to capture long-term therapeutic effects; future studies should incorporate extended follow-up periods. Third, the study sample consisted predominantly of female participants, which may limit the generalizability of the findings to the broader KOA population. Future studies should investigate larger sample sizes.

4. Conclusion and Recommendations

The present study demonstrates that both ELO and DG interventions produced significant improvements in mobility, dynamic balance, and lower limb muscle strength among patients with knee osteoarthritis over the 28-day treatment period. TUG and 30 CST scores in both groups transitioned from below-normal values at baseline to within the normal range at Day 28, reflecting clinically meaningful gains in functional performance and a substantial reduction in fall risk. The bioactive constituents of ELO, particularly *N. sativa* and Phlai, may have contributed to these therapeutic effects through their established analgesic and anti-

inflammatory properties. Notably, ELO demonstrated comparable efficacy to DG, suggesting its potential as an alternative topical intervention for the management of knee osteoarthritis. Nevertheless, these findings should be interpreted with caution, given the absence of a placebo control group. Future placebo-controlled trials are warranted to more rigorously establish the therapeutic efficacy of ELO in this patient population.

Acknowledgments

This research was financially supported by Phetchaburi Rajabhat University (Contract No. 021/2567). The authors extend their sincere appreciation to the Faculty of Nursing and Health Sciences, Phetchaburi Rajabhat University, and the Faculty of Integrative Medicine, Rajamangala University of Technology Thanyaburi, for providing the research instruments and for their continued support throughout the conduct of this study.

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