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IMPLEMENTATION OF CONTEXTUAL AND EXPERIMENTAL LEARNING THROUGH TRAINING ON YOGURT PRODUCTION FOR CHEMISTRY TEACHERS IN THE MGMP JAKARTA SELATAN 2

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Abstrak: Kimia sebagai mata pelajaran yang bersifat abstrak dan konseptual seringkali dianggap kurang menarik oleh siswa karena didominasi metode hafalan dan minim penerapan kontekstual. Hasil wawancara dengan siswa SMA menunjukkan bahwa pembelajaran berbasis eksperimen lebih efektif dalam meningkatkan pemahaman, namun implementasinya terkendala oleh keterbatasan fasilitas laboratorium, sehingga menurunkan relevansi materi dan motivasi belajar siswa. Kondisi ini mendorong pengembangan kompetensi guru dalam praktikum berbasis Contextual Teaching and Learning (CTL) melalui pembuatan yoghurt yang mengintegrasikan berbagai konsep Kimia serta isu lingkungan dan kesehatan berkelanjutan. Menanggapi kebutuhan tersebut, Tim Pengabdian kepada Masyarakat (PkM) UNJ telah menyelenggarakan pelatihan pembuatan yoghurt bagi 40 guru Kimia di lingkungan MGMP Kimia Jakarta Selatan 2. Kegiatan laboratorium awal telah dilakukan pada Mei–Juni 2024 di Laboratorium Biokimia FMIPA UNJ dan kegiatan inti PkM (meliputi pendahuluan, perencanaan dan persiapan, pelaksanaan, dan evaluasi) telah terlaksana pada Agustus 2024 di SMAN 70 Jakarta. Kegiatan ini berhasil meningkatkan keterampilan dan kreativitas guru dalam merancang pembelajaran Kimia yang kontekstual dan aplikatif, sesuai dengan prinsip Kurikulum Merdeka, serta mendukung pencapaian Tujuan Pembangunan Berkelanjutan (SDGs) poin ke-4 tentang pendidikan berkualitas. Para peserta juga merekomendasikan keberlanjutan program melalui pendampingan intensif dan penyusunan modul praktikum berbasis CTL yang terstandar.

Kata Kunci: Contextual Teaching and Learning, eksperimen, kimia, Kurikulum Merdeka Belajar, yoghurt

Abstract: The abstract and conceptual characteristics of chemistry often lead students to perceive the subject as less appealing, particularly when instruction relies heavily on rote memorization and lacks contextual relevance. Interviews with senior high school students indicate that experiment-based learning is more effective at enhancing understanding; however, its implementation is constrained by limited laboratory facilities, which reduces the relevance of the material and students' motivation to learn. This condition encourages the development of teachers' competencies in Contextual Teaching and Learning (CTL)–based laboratory activities through yogurt production, which integrates diverse chemistry concepts with environmental and sustainable health issues. To address this need, the UNJ Community Service (PkM) team conducted a yogurt production training program for 40 chemistry teachers from MGMP Jakarta Selatan 2. The preliminary laboratory activities were conducted from May to June 2024 at the Biochemistry Laboratory, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Negeri Jakarta, while the main Community Service (PkM) activities—including introduction, planning and preparation, implementation, and evaluation—were carried out in August 2024 at SMAN 70 Jakarta. The program successfully improved teachers' skills and creativity in designing contextual and applied chemistry learning in accordance with the principles of the Merdeka Belajar Curriculum, while also supporting the achievement of Sustainable Development Goal (SDG) 4 on quality education. The participants further recommended continuing the program through intensive mentoring and the development of standardized CTL-based laboratory modules.

Keywords: Contextual Teaching and Learning, experiment, chemistry, Merdeka Belajar curriculum, yogurt

Introduction

Chemistry exhibits an abstract nature (Armstrong & Poë, 2020) because numerous core concepts, including atomic structure, chemical bonds, and reaction energy, cannot be directly perceived through human senses. Understanding these concepts requires students to engage in higher-order thinking and scientific imagination. As chemistry is based on fundamental scientific laws (the law of conservation of mass and the laws of thermodynamics) and interrelated chemical theories, learning chemistry requires a strong conceptual understanding rather than simple memorization (Thompson, Bunch, & Popova, 2023). Moreover, this characteristic is strengthened by incorporating mathematical reasoning into topics such as stoichiometry, reaction kinetics, and chemical equilibrium, thereby contributing to the development of students' logical, quantitative, and problem-solving skills (Talanquer, 2022). In addition, chemistry learning involves three representational levels—macroscopic, microscopic, and symbolic. The macroscopic level allows students to observe tangible phenomena, such as color changes, precipitate formation, and gas release during chemical processes. The microscopic level provides explanations of observable phenomena by detailing particle interactions, movements, and configurational changes of atoms, ions, or molecules that are not directly visible. Whereas the symbolic level encodes chemical processes through chemical symbols, reaction equations, graphical representations, and diagrams microscopic level explains these phenomena at the particle level, including interactions, movements, and changes in the arrangement of atoms, ions, or molecules that cannot be observed directly. Meanwhile, the symbolic level is used to represent chemical processes through symbols, chemical formulas, reaction equations, graphs, and diagrams (Rahmawati et al., 2022). The interrelationship and integration of these three representational levels constitute a major challenge in chemistry learning, as students must connect observable phenomena, particle-level models, and chemical symbols to construct a comprehensive conceptual understanding.

Semi-structured interviews aimed at identifying learning challenges were conducted with senior high school students in MGMP Jakarta Selatan 2. The findings indicate that 40% of students found theoretical instruction uninteresting, primarily because it focused heavily on rote memorization of formulas and concepts with limited practical application, leading to rapid disengagement, especially under lecture-dominated teaching approaches. Approximately 60% of students reported that chemistry learning would be more engaging if delivered through laboratory experiments and practical activities, as such approaches facilitate a clearer understanding of chemical reactions through direct observation. However, limited laboratory facilities often lead to suboptimal practical implementation, rendering scientific concepts more abstract and challenging to comprehend. Students' limited awareness of chemistry's practical relevance in everyday life, perceptions of its irrelevance, and the lack of inspirational role models and real-world examples further contribute to reduced interest and learning motivation. Accordingly, initiatives are required to enhance teachers' skills and creativity in designing contextual chemistry practicums at the senior high school level, one of which is implemented through yogurt production activities. The integration of *Contextual Teaching and Learning* (CTL) with experimental approaches exemplifies the application of the *Merdeka Belajar* Curriculum in science education and contributes to achieving Sustainable Development Goal (SDG) 4, which emphasizes quality education.

Yogurt is produced through the fermentation of milk by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Hadjimbei, Botsaris, & Chrysostomou, 2022). This process produces a probiotic-rich food that supports gastrointestinal health, provides essential nutrients beneficial to the human body, and enhances immune function (Hadjimbei, Botsaris, & Chrysostomou, 2022; Kayisoglu, Schlegel, & Bartfeld, 2021). Probiotic bacteria help maintain intestinal microbial balance by suppressing the growth of pathogenic microorganisms, such as *Escherichia coli* and *Salmonella*, which may proliferate due to poor dietary habits, stress, or antibiotic use (Chandrasekaran, Weiskirchen, & Weiskirchen, 2024). This regulatory function is primarily achieved through the production of lactic acid, which lowers intestinal pH and creates unfavorable conditions for pathogenic bacteria (Anumudu et al., 2024), as well as through the synthesis of antimicrobial compounds, including bacteriocins and hydrogen peroxide, that inhibit or eliminate harmful microorganisms (Hussien et al., 2022; Kim et al., 2019).

As outlined earlier, Universitas Negeri Jakarta (UNJ) actively contributes to positive societal impact through the implementation of its Community Service Program (PkM). This initiative was carried out in collaboration with the Chemistry Teacher Working Group (MGMP) Jakarta Selatan 2 in the form of a yogurt production training program conducted at SMAN 70 Jakarta. The successful implementation of comparable programs with the MGMP Jakarta Timur 1 in 2022 (Kartika et al., 2023a) and MGMP Jakarta Timur 2 in 2023 (Kartika et al., 2023b) further supported the effectiveness and smooth execution of the present activity. The MGMP Jakarta Selatan 2 comprises public and private senior high schools located across the Tebet, Setiabudi, Pancoran, and Mampang Prapatan districts. This community service program aims to enhance teachers' conceptual understanding, practical competencies, and creativity in integrating fundamental chemistry concepts into everyday contexts, particularly through research-based yogurt production practical activities.

Method

The yogurt production process, along with a series of product quality evaluations, was conducted as a preliminary activity at the Biochemistry Laboratory, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Negeri Jakarta (UNJ), from May to June 2024. The materials and equipment used included full-cream milk from various brands, plain yogurt starter (Biokul), flavoring agents, fresh fruits, cookware and heating devices, packaging containers, measuring tools, thermometers, pH indicators, test tubes, as well as instruments for nutritional value analysis, microbial contamination assessment, and heavy metal detection. The experimental procedures encompassed milk fermentation, yogurt quality testing—including nutritional content, microbial contamination, and heavy metal analysis—and organoleptic tests covering appearance, aroma, and taste. Subsequently, the PkM program was implemented over two weeks in August 2024 through four stages: (1) preliminary activities; (2) planning and preparation; (3) implementation; and (4) evaluation, as schematically presented in Figure 1.

Preliminary Stage

Preliminary data collection was conducted in March 2024 through semi-structured interviews to investigate senior high school students' learning experiences and responses to chemistry instruction within MGMP Jakarta Selatan 2. Interview guidelines and observation instruments were prepared by the PkM team, with 65 students participating as respondents.

Planning and Preparation Stage

During May–June 2024, the planning stage was undertaken through the preparation of instructional materials and the sourcing of laboratory equipment from the Biochemistry Laboratory for school demonstrations, the development of socialization modules, and the scheduling of activity implementation.

Implementation Stage

The third stage, conducted over two weeks in August 2024, comprised socialization activities delivered through module-based presentations, yogurt production demonstrations, and interactive discussion and question-and-answer sessions. The socialization was implemented in two sessions, each lasting 120–150 minutes. Several instructional techniques and methods were applied, including:

a. Lecture method, involving educational sessions for participants on nutritional comparisons between milk and yogurt, types and benefits of yogurt, and yogurt storage processes.
b. Demonstration (training) method, involving hands-on demonstrations of producing fermented beverages based on research data.
c. Question-and-answer sessions on yogurt, covering production stages, nutritional value, and storage.

Evaluation Stage

The evaluation stage involved asking teachers to complete evaluation forms assessing the materials, methods, and benefits of the activity. The team subsequently analyzed the results to determine participants' levels of understanding, skills, and satisfaction, and to formulate follow-up actions and improvements for future activities, prior to the closing of the training program.

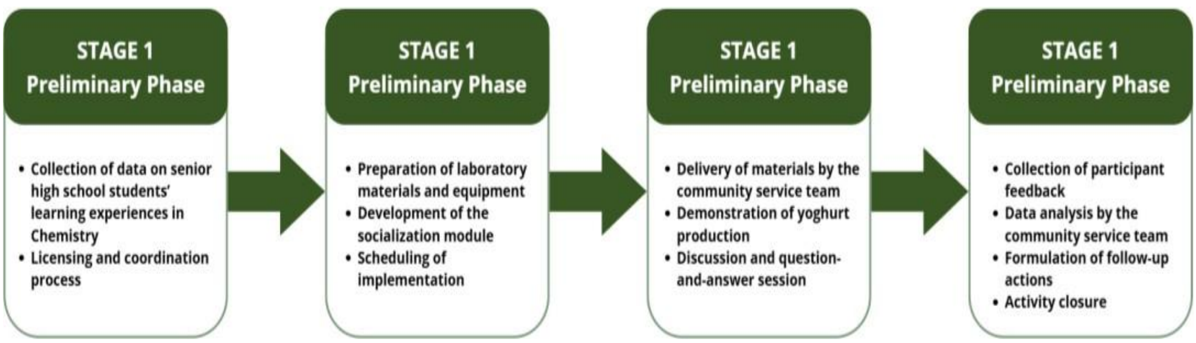

Figure 1. Stages of the PkM Program Implementation

Results and Discussion

The PkM activity was conducted at SMAN 70 Jakarta (Figure 2), a member of the MGMP Jakarta Selatan 2, which serves as a professional forum for chemistry teachers to discuss, share experiences, and enhance their professional competencies. A total of 40 teachers actively participated in the activity, which was implemented in two sessions on August 1 and 8, 2024.

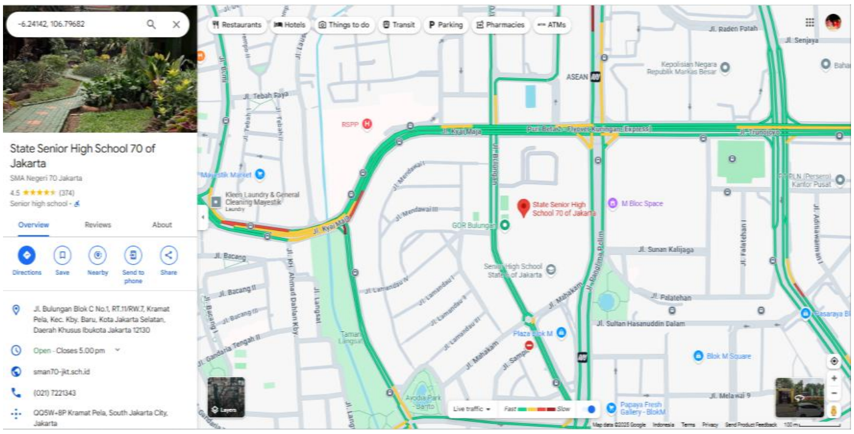

Figure 2. Location of SMAN 70 Jakarta (the site for the community service program)

Activities in the Biochemistry Laboratory, FMIPA, Universitas Negeri Jakarta

Yogurt production and a series of product quality evaluations were carried out at the Biochemistry Laboratory of FMIPA, UNJ, during May–June 2024, following several stages described below:

Milk Fermentation

In this experiment, 1 L of full-cream milk and 80 mL of Biokul were used, with fermentation durations evaluated at <18 h, 18–24 h, and >24 h. Biokul was selected as the starter culture due to its commercial availability and practical application, as it does not require a specialized activation process (Putri et al., 2021). Biokul contains high levels of active lactic acid bacteria, specifically *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Unlike pure bacterial cultures, the use of Biokul does not necessitate strict sterile conditions and is therefore more economical than culture-based starters (Putri et al., 2021).

Nutritional Value Test of Fermented Yogurt

Proximate analysis comprised the determination of carbohydrate content, total protein, total fat, total energy, moisture content, and ash content. Carbohydrate analysis in yogurt was performed to assess carbohydrate levels relevant to nutritional value, product quality, and labeling, as well as to monitor residual lactose and fermentation progress (Panseri et al., 2021). Total protein determination was conducted to quantify protein content, which is critical for nutritional quality, product characteristics, labeling accuracy, fermentation monitoring, and the identification of potential allergens (Wang et al., 2025). Total fat content analysis aimed to determine lipid levels that directly influence nutritional value, sensory properties, shelf life, labeling information, product consistency, storage stability, and product classification (Kim et al., 2020). Moisture content determination was essential due to its impact on product quality, stability, and labeling accuracy, as well as its role in texture evaluation, quality control, shelf-life assessment, production efficiency, and the reliability of nutritional data (Famuji, Zulaikhah, & Sidhi, 2023). Ash content analysis was conducted to estimate total mineral content, including calcium, potassium, sodium, and magnesium, to ensure product quality, detect potential contamination, support nutritional labeling, and verify compliance with established standards (Rana, Babor, & Sabuz, 2019). The results of nutritional composition analysis, microbiological contamination testing, and heavy metal content assessment were compared with the requirements specified in the Indonesian National Standard (SNI) (National Standardization Agency, 2009), as presented in Table 1. Based on these data, the nutritional composition of the produced yogurt complied with the SNI requirements.

Microbial Contamination Test

Microbial contamination testing in yogurt was conducted to ensure product safety, quality, and hygiene, to comply with regulatory requirements, and to protect consumers from diseases caused by pathogenic microorganisms, particularly *Coliform* bacteria, *Salmonella*, and *Listeria* (Onasanya et al., 2019). As shown in Table 1, the microbial counts detected in yogurt products remained within the permissible limits specified by SNI.

Metal Contamination Test

Heavy metal contamination testing was conducted to assess product safety, protect consumer health, ensure the quality and purity of yogurt, verify the hygiene of the production process, and ensure compliance with applicable food regulations and standards (Khalid et al., 2024). As presented in Table 1, the metal concentrations detected in the yogurt samples were within the maximum permissible limits established by SNI.

Table 1. Comparison of Nutritional Value, Microbial Contamination, and Metal Contamination Test Results in Yogurt with SNI

No	Test Criteria	Unit	Yogurt meets SNI	Yogurt Product
1	Condition			
1.1	Appearance	-	Thick liquid - solid	Thick liquid - solid
1.2	Aroma	-	typical yogurt aroma	typical yogurt aroma
1.3	Flavor	-	typical yogurt sour taste	typical yogurt sour taste
2	Fat content (b/b)	%	Min. 3.0	6.0
3	Total Non-fat Milk Solids (b/b)	%	Min. 8.2	8.5
4	Protein (Nx6,38) (b/b)	%	Min. 2.7	7.0
5	Ash Content (b/b)	%	Max. 1.0	-
	Moisture Content	-	-	-
6	Acidity (calculated as lactic acid) (b/b)	%	0.5-2.0	0.4
7	Metal Contamination			
7.1	Lead (Pb)	mg/kg	Max. 0.3	0.003
7.2	Copper (Cu)	mg/kg	Max. 20.0	0.02
7.3	Tin (Sn)	mg/kg	Max. 40.0	0.06

No	Test Criteria	Unit	Yogurt meets SNI	Yogurt Product
7.4	Mercury (Hg)	mg/kg	Max. 0.03	0.008
8	Arsenic	mg/kg	Max. 0.1	0.05
9	Microbial Contamination			
9.1	*Coliform* Bacteria	colony/g	Max. 10	9.2
9.2	*Salmonella*	-	Negative/25g	Negative/25g
10	*Listeria monocytogenes*	-	Negative/25g	Negative/25g

Organoleptic Test of Yogurt

Organoleptic testing was conducted to evaluate sensory attributes—namely appearance, aroma, and taste—which play a crucial role in consumer acceptance. This evaluation aimed to identify consumer preferences, ensure the stability of sensory quality, support innovation and product development, and enhance yogurt's market competitiveness (Faisal, Saifullah, & Mukhriza, 2019). The organoleptic assessment involved 40 respondents who evaluated yogurt samples based on visual appearance, aroma, and flavor. Based on the data presented in Table 2 and Table 3, most participants expressed positive responses toward yogurt with a layered appearance, a milky aroma with a slight acidic nuance, and a predominantly sour taste as the dominant sensory characteristic.

Table 2. Results of Sensory Evaluation of Yogurt at Various Fermentation Times

Physical Condition	Fermentation Time								
	< 18 hours			18 – 24 hours			< 24 hours		
Test Criteria	1*	2*	3*	1*	2*	3*	1*	2*	3*
Appearance									
Rep. 1	30	6	4	0	37	3	3	2	35
Rep. 2	36	3	1	0	38	2	0	1	39
Rep. 3	38	1	1	1	39	0	1	0	39
Mean	**35**	**3**	**2**	**0**	**38**	**2**	**1**	**1**	**38**
Aroma									
Rep. 1	35	2	3	2	36	2	0	2	38
Rep. 2	37	1	2	1	38	1	2	1	37
Rep. 3	39	0	1	2	38	0	1	1	38
Mean	**37**	**1**	**2**	**2**	**37**	**1**	**1**	**1**	**38**
Flavor									
Rep. 1	39	0	1	2	36	2	4	0	36
Rep. 2	36	2	2	1	39	0	0	1	39
Rep. 3	37	3	0	0	38	2	1	2	37
Mean	**37**	**2**	**1**	**1**	**38**	**1**	**2**	**1**	**37**

*Remarks

1. Appearance evaluation: score 1 = liquid, milk-like consistency
   score 2 = layers formation
   score 3 = uniformly thick consistency
2. Aroma evaluation: score 1 = milky aroma
   score 2 = milky with slight yogurt aroma
   score 3 = typical yogurt aroma
3. Flavor evaluation: score 1 = slight yogurt's sour with a slight sweetness
   score 2 = yogurt's sour taste
   score 3 = yogurt's sour and bitter taste

Table 3. Organoleptic Characteristics and Overall Acceptability of Yogurt at Different Fermentation Durations

Scale	Fermentation < 18 hours			Fermentation 18 – 24 hours			Fermentation > 24 hours		
	Appearance	Aroma	Flavor	Appearance	Aroma	Flavor	Appearance	Aroma	Flavor
5*	0	0	0	35	37	38	0	0	0
4*	7	0	8	3	2	2	0	0	0
3*	10	2	0	2	1	0	5	5	5
2*	23	36	32	0	0	0	25	30	5
1*	0	2	0	0	0	0	10	5	30
Total	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**

*5: Strongly Like; 4: Like; 3: Neutral; 2: Dislike; 1: Strongly Dislike

Implementation of PkM Activity at MGMP Jakarta Selatan 2

The opening ceremony of the PkM activity was held on Thursday, 1 August 2024, at 08:30 (UTC+7) at SMAN 70 Jakarta. Subsequently, the PkM UNJ team delivered instructional materials covering yogurt-related knowledge and theoretical concepts, including comparisons of the nutritional content of milk and yogurt, types of yogurt, health benefits, and yogurt storage procedures (Figure 3). Prior to the material presentation, participants completed a pretest questionnaire consisting of ten questions to assess their initial level of understanding of yogurt-related topics. The same set of questions was used for both the pretest and post-test, as presented in Table 4.

Figure 3. Preparation by PkM Team on Thursday, 1 August 2024, at SMAN 70 Jakarta

Various reasons for milk avoidance are primarily associated with gastrointestinal discomfort, including diarrhea, abdominal bloating, and excessive flatulence after consuming milk or dairy products (Al-Beltagi et al., 2022). These symptoms are commonly experienced by individuals with lactose intolerance, a digestive disorder caused by a deficiency of the lactase enzyme in the small intestine, leading to incomplete lactose digestion (Forsgård, 2019). Physiologically, the human body requires lactase to hydrolyze lactose into glucose and galactose, which are subsequently metabolized in energy pathways (Forsgård, 2019). Although lactose intolerance is not a life-threatening condition, its symptoms can cause significant discomfort and reduce dietary tolerance.

As an alternative, yogurt has been developed as a fermented dairy product through the metabolic activity of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, which partially hydrolyze lactose during fermentation, thereby facilitating digestion and making yogurt more suitable for individuals with lactose intolerance (Hadjimbei et al., 2022). The activity concluded with a question-and-answer session, followed by the PkM UNJ team disseminating information on the schedule for the subsequent meeting, held on Thursday, 8 August 2024, at SMAN 70 Jakarta.

A brief demonstration of the yogurt production process was conducted on Thursday, 8 August 2024, at SMAN 70 Jakarta (Figure 4). The procedure began by heating the milk to 65–70 °C, then cooling it to approximately 50 °C. A yogurt starter culture (plain yogurt, Biokul brand) was then added and mixed thoroughly. The mixture was fermented in a closed container in the dark for 18–24 hours and subsequently cooled to 4–7 °C for 3–7 hours before consumption, with or without flavorings or fresh fruit. A video demonstrating the yogurt production steps is available online via YouTube (https://www.youtube.com/watch?v=UhB-wjy2nck). The final yogurt product obtained from the fermentation process is shown in Figure 5.

Table 4. Pretest and Post-test Questions for Teachers

No	Pretest dan Post Test Questions
1	The primary ingredient of yogurt is milk of: (A. cow, goat, buffalo; B. soybean; C. almond; D. wheat or oatmeal)
2	Lactose is a disaccharide found in milk, composed of: (A. glucose and glucose; B. glucose and fructose; C. glucose and galactose; D. glucose and mannose)
3	Yogurt is produced through a simple biotechnology process known as: (A. hydrolysis; B. glycolysis; C. fermentation; D. substitution)
4	Lactic acid bacteria responsible for yogurt production are: (A. *Lactobacillus bulgaricus* and *Streptococcus thermophilus*; B. *Lactobacillus bulgaricus* and *Streptococcus pneumoniae*; C. *Lactobacillus acidophilus* and *Streptococcus thermophilus*; D. *Lactobacillus acidophilus* and *Streptococcus pneumoniae*)
5	Lactic acid bacteria convert lactose in yogurt into: (A. glucose; B. galactose; C. lactic acid; D. fructose)
6	The sour taste of yogurt is caused by the presence of: (A. acetic acid; B. sulfuric acid; C. nitric acid; D. lactic acid)
7	Yogurt contains high levels of: (A. water; B. sugar; C. acid; D. protein)
8	According to SNI (2009), the pH range of yogurt is approximately: (A. 1.00–2.70; B. 2.70–3.80; C. 3.80–4.50; D. 4.50–5.50
9	The optimum temperature for yogurt storage to maintain shelf life is: (A. room temperature; B. 4–7 °C; C. freezer temperature; D. above 50 °C)
10	Individuals with lactose intolerance lack the enzyme: (A. lactase; B. lactose; C. galactose; D. galactase)

Figure 4. Demonstration of Yogurt Production on Thursday, 8 August 2024, at SMAN 70 Jakarta

Figure 5. Yogurt Product

The question-and-answer session provided teachers with an opportunity to engage with the PkM UNJ team on implementing the *Merdeka Belajar* Curriculum in science learning, particularly through the integration of CTL and experimental activities. CTL emphasizes connecting learning materials to students' real-life contexts, such as healthy dietary habits, the use of microorganisms in the food industry, and fermentation processes as natural chemical reactions in food (Mukhlishin, 2024). In this framework, yogurt can serve as a foundation for teachers to design relevant and applicable chemistry learning activities. In Organic Chemistry, yogurt can be used to explore hydrolysis reactions, molecular structures, types of interatomic bonds, constituent elements, relative molecular mass, and physical and chemical properties, including qualitative tests for its components. From an Analytical Chemistry perspective, yogurt can be analyzed using ultraviolet (UV) and infrared (IR) spectroscopy, liquid chromatography–mass spectrometry (LC-MS), quantitative analyses, concentration calculations, applications of the mole concept, and pH measurements of its constituents. Biochemically, yogurt is relevant for studying fermentation processes, metabolic pathways, the functions and benefits of bioactive compounds, lactase enzyme activity, and their association with health conditions, preventive strategies, and treatments related to excess substances in the human body. In Physical Chemistry, yogurt can illustrate concepts in chemical kinetics, particularly the reaction rates involved in the formation and decomposition of its constituent compounds.

Table 5. Pretest and Post-test Score Comparison of Participants

Score	Number of Participants		Percentage (%)	
	Pretest	Post test	Pretest	Post test
5	15	0	37.5	0.0
6	10	0	25.0	0.0
7	10	5	25.0	12.5
8	5	10	12.5	25.0
9	0	15	0.0	37.5
10	0	10	0.0	25.0

Teachers can integrate yogurt-related topics with environmental issues, highlighting fermentation as a relatively environmentally friendly production process. This process includes using whey, a liquid by-product of yogurt production, as a raw material for animal feed or organic fertilizer (Rocha-Mendoza et al., 2021), adopting eco-friendly packaging, and promoting local and organic yogurt products, which help reduce carbon footprints by minimizing long-distance distribution. The application of CTL in this context can involve assigning students tasks to discuss the environmental impacts of consuming fermented foods, conducting science projects on yogurt production using biodegradable or recyclable packaging, and analyzing case studies on waste management and recycling practices in the fermented food industry.

Following the interactive discussion session, participants completed a post-test. The results of the pretest and post-test are presented in Table 5 and Figure 6. In the pretest, the highest score achieved was 8 (12.5%), indicating that participants' initial understanding of yogurt-related topics was relatively low. After the instructional activities—including lectures, yogurt-making demonstrations, and interactive question-and-answer sessions covering nutritional content, types, health benefits, storage, and production processes—a marked improvement in participants' understanding was observed. This improvement is reflected in the post-test results, where the highest score reached 10 (25%).

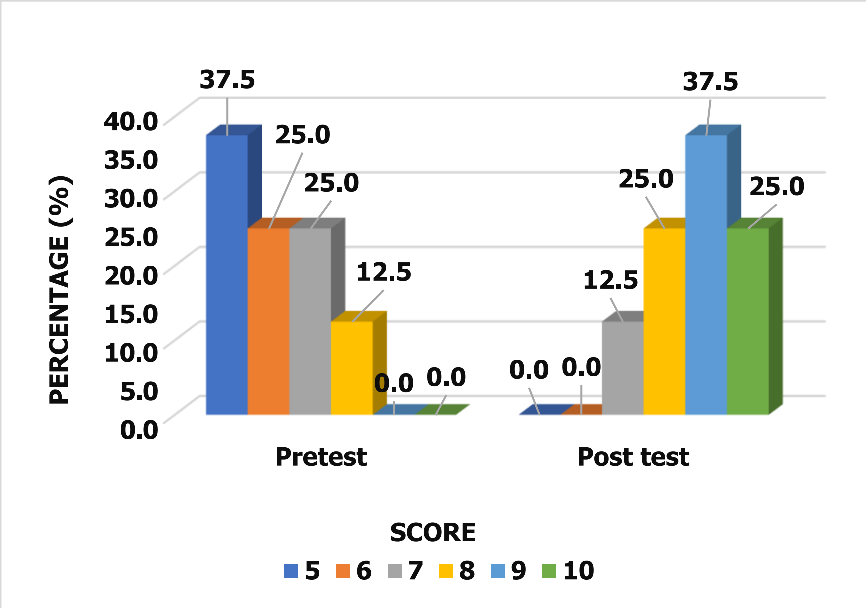

Figure 6. Distribution of Participants' Scores in Pretest and Post-test

Table 6. List of Questions and Summary of Participants' Feedback

No	Statement	4*	3*	2*	1*
1	I understand the theoretical concepts and knowledge related to yogurt, including its nutritional content, types, health benefits, and storage methods.	**95.0%**	**5.0%**	0%	0%
2	I am satisfied with the instructor's method of presenting theoretical knowledge on yogurt.	92.5%	7.5%	0%	0%
3	I am satisfied with how the facilitator demonstrated the yogurt production procedure.	92.5%	7.5%	0%	0%
4	The topic presented was relevant and met my expectations.	92.5%	7.5%	0%	0%
5	The topic presented inspired me to develop new ideas for implementing interactive learning in the classroom.	**95.0%**	**5.0%**	0%	0%
6	The presenter explained yogurt-related material clearly and simply, providing practical examples from daily life.	**95.0%**	**5.0%**	0%	0%
7	The time allocated for the training was adequate.	90.0%	10.0%	0%	0%
8	The presenter provided clear and comprehensive answers to all participants' questions.	**95.0%**	**5.0%**	0%	0%
9	The training was conducted smoothly and successfully.	90.0%	10.0%	0%	0%
10	I gained new information and insights about yogurt after the training.	92.5%	7.5%	0%	0%
11	I intend to disseminate the knowledge I have acquired about yogurt to the local community.	**95.0%**	**5.0%**	0%	0%

*4 = Strongly Agree; 3 = Agree; 2 = Less Agree; 1 = Disagree

The evaluation stage was conducted through a structured feedback questionnaire designed to assess the implementation of the community service activity, as summarized in Table 6. The results indicate that participants demonstrated a high level of understanding of theoretical knowledge about yogurt, including its nutritional aspects, types, benefits, and storage processes (95%). The material delivered was perceived as inspiring, particularly in fostering the development of new ideas for implementing interactive learning approaches in classroom settings (95%). Participants also reported that the UNJ community service team presented the content comprehensively, using clear, accessible language and relevant, practical examples from everyday contexts (95%). All questions raised by participants were addressed clearly and satisfactorily (95%). Furthermore, participants demonstrated a strong motivation to share the knowledge and insights gained about yogurt with the broader community in their local environments (95%).

Conclusion

The Community Service Program (PkM) on yogurt production positively contributed to the development of teachers' competencies, particularly in designing learning activities that integrate the *Contextual Teaching and Learning* (CTL) approach with experimental methods. This instructional combination aligns with the core principles of the *Merdeka Belajar* Curriculum and supports the achievement of the *Sustainable Development Goals* (SDGs). The sustainability of the PkM program is ensured through continuous teacher mentoring to maintain the long-term impact of experiment-based contextual learning in classrooms. Such mentoring facilitates the development and implementation of standardized CTL-based practicum modules in accordance with the *Merdeka Belajar* Curriculum while providing ongoing feedback to address challenges and enhance learning quality. Consequently, the program has the potential to maximize educational outcomes, strengthen teachers' competencies, improve the quality of chemistry education, and contribute to the realization of the SDGs.

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