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Capacity Building in Halal Food Education and Certification for Agricultural Vocational High School Students through a Local Potential-Based Approach in Riau

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ABSTRACT

Background: The halal industry is a rapidly growing sector with significant potential in Indonesia, particularly in Riau Province, which is known as a center of coconut- and palm oil-based agroindustry. However, halal literacy, especially regarding the Halal Product Assurance System (SJPH) and certification procedures, remains low among vocational high school students.
Aims: This community service program aims to improve students' understanding and competence in halal food and certification through a contextual, practice-based learning approach.
Methods: A quantitative method with a pre-experimental one-group pretest–posttest design was applied to 25 students of SMK Negeri Pertanian Terpadu Riau. Data were collected through tests, observation, and documentation, and analyzed using paired sample t-test and N-Gain.
Result: The results showed a significant improvement in students' scores, with the mean increasing from 72.53 to 88.00 and a t-value of 9.43 exceeding the critical value (2.064) at a 5% significance level. The N-Gain score of 0.56 indicates moderate effectiveness. The program also enhanced students' higher-order thinking skills in identifying halal critical points and certification procedures. This activity effectively improves halal literacy and can serve as a relevant learning model for strengthening vocational competencies in the halal industry.

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1. Introduction

The halal industry is one of the fastest-growing sectors globally, driven by increasing public awareness of the importance of consuming products that are safe, high-quality, and compliant with Islamic principles. Indonesia, as the country with the largest Muslim population in the world, has significant potential for the development of the halal industry, particularly in the food sector (Bahri & Efendi, 2023; Maulizah & Sugianto, 2024). This potential is also evident at the regional level, including in Riau Province, which is known as a center for plantation-based agroindustry, especially coconut and palm oil. Derivative products from these commodities have substantial opportunities to be developed into high value-added halal products for both domestic and export markets. However, these coconut- and palm-based derivative products often involve complex and multi-stage processing chains, including the use of additives, processing aids, catalysts, and potential cross-contamination during handling and storage, which may originate from non-halal sources. These conditions create specific halal critical points that require careful identification and control throughout the production process.

In addition, the presence of micro, small, and medium enterprises (MSMEs/UMKM) in the processed food sector further strengthens the halal industry ecosystem in Riau. However, the utilization of this potential still faces several challenges, particularly in terms of halal literacy, understanding of the Halal Product Assurance System (SJPH), and the readiness of human resources to meet halal certification standards. Within the SJPH framework, the role of the Badan Penyelenggara Jaminan Produk Halal (BPJPH) (*Halal Product Assurance Organizing Agency*) as the regulatory authority and the Lembaga Pemeriksa Halal (LPH) (*Halal Inspection Institution*) as the body responsible for conducting halal audits and inspections is crucial in ensuring the credibility and integrity of the certification process. Therefore, structured educational and mentoring efforts are needed to improve public understanding, including through vocational education pathways, regarding the concepts and implementation of halal assurance systems.

In this context, vocational high schools (SMK), as educational institutions oriented toward workforce readiness, play a strategic role in producing graduates who are competent and aligned with industry needs, including the halal food industry. However, students' understanding of halal concepts remains limited, not only in normative aspects but also in technical aspects such as identifying halal critical control points, implementing halal-compliant production processes, and understanding halal certification procedures. This condition indicates a gap between graduates' competencies and the evolving demands of the halal industry.

This gap becomes increasingly critical in the context of national regulatory implementation, particularly with the enforcement of Law Number 33 of 2014 on Halal Product Assurance, which has been mandatory since October 2019 (Arsil et al., 2022; Hamidatun & Pujilestari, 2022). Various studies indicate that the level of halal literacy remains suboptimal, both among business actors and students, particularly in understanding regulations and the implementation of the Halal Product Assurance System (SJPH) (Gunawan *et al.,* 2021; Purnama *et al.,* 2024). Therefore, systematic and practical educational efforts are needed to enhance halal literacy among vocational high school (SMK) students, particularly in the fields of agriculture and food processing. Previous studies have also shown that training and

mentoring can significantly improve knowledge and compliance with the Halal Product Assurance System (SJPH) (Hamidatun & Pujilestari, 2022; Siska *et al.,* 2020; Tandepadang *et al.,* 2023).

To enhance learning effectiveness, experience-based approaches such as contextual learning and hands-on practice are essential. The constructivist approach emphasizes that understanding is optimized when learners actively construct knowledge through meaningful learning experiences (Abdiyah & Subiyantoro, 2021; Anjelita & Supriyanto, 2024; Datuzuhriah *et al.,* 2025). In addition, the Contextual Teaching and Learning (CTL) approach emphasizes the importance of connecting learning materials with real-life situations. This is in line with the definition of CTL, which states that learning should relate the content being taught to the students' real-life experiences (Sunhaji, 2014). A similar perspective is also expressed by Yuniastuti (2020), who emphasizes that CTL connects learning materials with real-world contexts, making the learning process more meaningful and easier for students to understand.

Based on this background, this community service program was designed to provide education and mentoring on halal food and halal certification to students of SMKN Pertanian Terpadu Provinsi Riau. The program aims to enhance students' understanding and competencies in identifying halal aspects of food products, understanding halal certification procedures, and applying halal food production principles in practice.

Through this program, students are expected not only to gain theoretical knowledge but also to develop practical skills relevant to industry needs. In addition, this activity is expected to serve as an effective alternative learning model in strengthening vocational high school graduates' competencies in the halal industry, particularly in the context of developing local potential based on agriculture and food sectors.

2. Methods

This community service activity employed a quantitative approach with a pre-experimental design, specifically a one-group pretest–posttest design. The design was used to measure changes in participants' understanding before and after the intervention, which consisted of halal food education and halal certification training. The participants were 25 students from SMKN Pertanian Terpadu Provinsi Riau, with academic backgrounds in agribusiness and agricultural product processing. All participants were vocational high school students and had not previously received formal training or certification as halal auditors or food professionals.

The activity was implemented in three main stages: preparation, implementation, and evaluation. The preparation stage involved the development of learning materials and research instruments. The test instrument was developed based on a structured question grid referring to cognitive levels ranging from lower-order thinking skills (LOTS) to higher-order thinking skills (HOTS). The validity of the instrument was assessed through expert judgment, while its reliability was tested using internal consistency analysis (Cronbach's Alpha), calculated using the formula:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma^2_{\text{item}}}{\sigma^2_{\text{total}}}\right)$$

where k represents the number of items, σ²_item is the variance of each item, and σ²_total is the total variance of the test scores, ensuring that the instrument was appropriate for measuring participants' understanding.

The implementation stage included educational sessions, discussions, and practical activities related to halal food and certification processes. The training was conducted in 3 sessions over one days, allowing participants to gradually build their understanding. The evaluation stage was conducted through pretest and posttest assessments to measure the improvement in participants' understanding. Data were collected using several techniques, including tests (pretest and posttest) to assess cognitive abilities,

observation to examine participants' engagement and responses during the activities, and documentation in the form of photographs and activity records as supporting data.

Data analysis in this study was carried out using three main approaches: paired sample t-test, normalized gain (N-Gain) test, and descriptive analysis. Prior to conducting the paired sample t-test, a normality test (Shapiro–Wilk test) was performed using the formula:

$$W = \frac{\left(\sum_{i=1}^{n} a_i \; x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where W is the test statistic, a_i are constants derived from the covariance matrix, $x_{(i)}$ are ordered sample values, and $\bar{x}$ is the sample mean, to ensure that the data met the assumptions required for parametric analysis.

The paired sample t-test was used to determine whether there was a significant difference between the mean pretest and posttest scores within the same group. The analysis was conducted by comparing the calculated t value ($t_{(calculated)}$) with the critical t value ($t_{(table)}$) at a 5% significance level. If $t_{(calculated)}$ was greater than $t_{(table)}$, it indicated a significant difference before and after the intervention. The formula used was:

$$t = \frac{\bar{d}}{S_d/\sqrt{n}}$$

where d represents the mean difference between posttest and pretest scores, Sd is the standard deviation of the differences, and n is the sample size. The mean difference was calculated as:

$$\bar{d} = \frac{\sum d_i}{n}$$

while the standard deviation of the differences was calculated as:

$$S_d = \sqrt{\frac{\sum (d_i - \bar{d})^2}{n-1}}$$

Furthermore, the N-Gain test was employed to measure the effectiveness of learning improvement after the intervention. The N-Gain value was calculated based on the difference between pretest and posttest scores normalized to the maximum possible score using the formula:

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

where S_{post}= is the posttest score, S_{pre} is the pretest score, and S_{maks} is the maximum score (typically 100). The effectiveness category followed Hake (1999), where $g > 0.7$ is considered high, $0.3 \leq g \leq 0.7$ is moderate, and $g < 0.3$ is low.

In addition, descriptive analysis was conducted to determine the mean (average) scores of pretest and posttest as a general representation of participants' understanding before and after the learning process. The mean was calculated using the formula:

$$\bar{X} = \frac{\sum X}{n}$$

where $\bar{X}$ is the mean score, X represents individual scores, and n is the number of participants.

The success indicators of this activity were defined as follows: the average posttest score is higher than the pretest score, the t-test shows a statistically significant difference ($p < 0.05$), the N-Gain value reaches at least the moderate category, and participants demonstrate improvement in both cognitive understanding and practical application.

3. Results and Dicussion

Based on the implementation of the community service program involving 25 agricultural vocational high school students, pretest and posttest data were obtained to measure participants' level of understanding before and after the learning intervention. The comparison of pretest and posttest scores indicates a considerable improvement in participants' understanding, as presented in Figure 1.

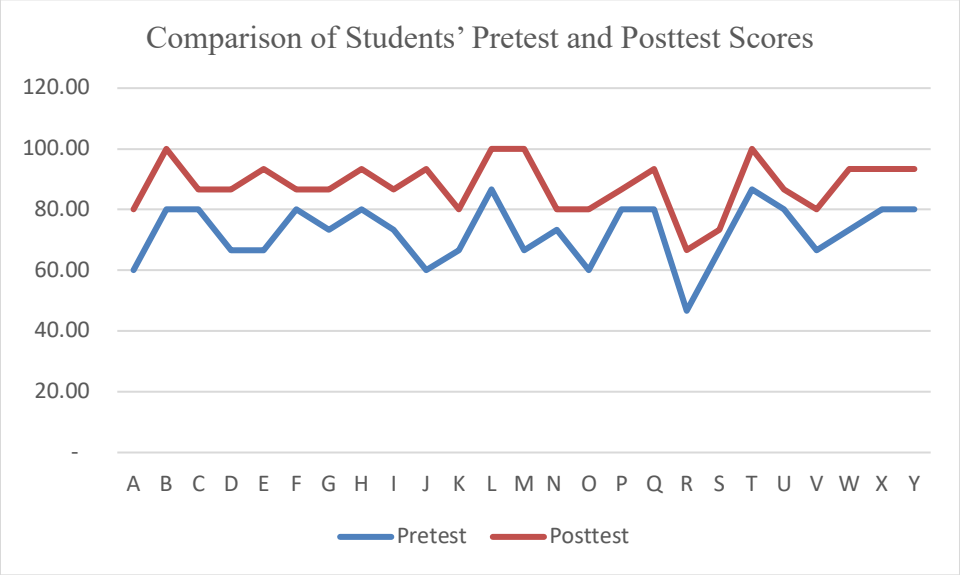


Figure 1. Comparison of Participants' Pretest and Posttest Results

The reliability of the instrument was first assessed using Cronbach's Alpha. The results showed that the pretest instrument had a coefficient of 0.74, indicating acceptable reliability, while the posttest instrument achieved a higher coefficient of 0.86, indicating high reliability. These findings suggest that the instrument was sufficiently consistent in measuring students' understanding. Prior to conducting the parametric test, a normality test using the Shapiro–Wilk method was performed, showing that both pretest ($p = 0.39$) and posttest ($p = 0.27$) data were normally distributed ($p > 0.05$). This indicates that the assumption for applying the paired sample t-test was fulfilled.

The results of the paired sample t-test indicate a significant difference between the pretest scores (mean = 72.53) and posttest scores (mean = 88.00). The calculated t value of 9.43 is greater than the t table value at the 5% significance level ($t = 2.064$), leading to the rejection of H_0. This finding confirms that the learning intervention was statistically effective in improving students' understanding. Inferentially, this improvement can be attributed as a direct impact of the treatment provided.

These results are consistent with previous studies reporting improvements in cognitive achievement following learning interventions, particularly in aspects of problem-solving (Siswanto & Yulaikah, 2023), as well as a significant increase in knowledge (Aini & Vinaya, 2026). This finding not only demonstrates the statistical effectiveness of the learning intervention but also highlights its contextual relevance to regional needs. In the context of Riau Province as one of the centers of coconut- and palm oil–based agroindustry, improving students' understanding of the Halal Product Assurance System (SJPH) is crucial in supporting the development of value-added halal products and enhancing the competitiveness of local industries.

Further analysis at the individual level shows that almost all participants experienced an increase in their scores. Several participants even achieved the maximum score (100) on the posttest, while those with lower initial scores also demonstrated considerable improvement. This indicates that the learning intervention was inclusive and effective in improving learning outcomes across different levels of initial ability.

At the item level, there was an increase in the percentage of correct answers across most indicators. The most notable improvements were observed in items that initially had low success rates, whereas items that already had high success rates in the pretest showed little change. This pattern suggests that the learning intervention had a greater impact on aspects that were previously less understood by the participants.

This improvement is not only quantitative, as reflected in the increase in average scores, but also qualitative in terms of enhanced conceptual understanding. The instrument covered a range of cognitive levels, from basic comprehension to analytical skills. Items at the basic conceptual level showed relatively high mastery from the beginning, while more substantial improvements were observed in items requiring applicative and analytical understanding, such as critical points of halal assurance, contamination in production processes, and the halal product assurance system.

These findings indicate that the learning intervention not only strengthened lower order thinking skills (LOTS) but also promoted the development of participants' higher order thinking skills (HOTS). Thus, the learning process has gone beyond mere knowledge transfer toward the formation of deeper and more structured understanding. This is consistent with various studies showing that HOTS-based learning can enhance critical thinking, argumentative abilities, and complex problem-solving skills. Strengthening higher-order thinking skills is highly relevant in the context of developing the halal industry in the region. In Riau Province, analytical skills in identifying critical halal points, potential contamination, and halal certification processes are essential competencies required in the processing of coconut- and palm oil–based agroindustrial products.

Moreover, the observed improvement also indicates a correction of participants' initial misconceptions, particularly regarding halal institutions and production processes. This phenomenon supports constructivist theory, which posits that learning is a process of knowledge reconstruction (Alaudin & Missouri, 2023; Hairunisya, 2020; Hermawati & Safitri, 2023; Hidayah *et al.,* 2024; Londa & Domu, 2020).

The analysis of the true/false items also reveals the development of participants' conceptual understanding. Participants began to recognize that the halal status of a product is determined not only by its raw materials but also by the production process, the equipment used, and the management system applied. This reflects a shift from partial understanding to a more holistic perspective. These findings are consistent with previous studies indicating that halal understanding is not solely focused on substances, but also includes the methods of obtaining and processing products. In contrast, Azzahra *et al.* (2026) found that, at the initial stage, students tend to have a narrow perspective, associating halal only with the absence of alcohol and pork without considering production processes. This holistic perspective is further supported by Syafiah & Qodariyah (2022) and Jufrinaldi *et al.* (2025) who emphasize that halal encompasses materials, equipment, processes, and production facilities in an integrated manner.

The improvement in learning outcomes was also influenced by the quality of the instructional materials used. The materials were systematically structured, covering fundamental concepts to applicative aspects, and delivered in a gradual manner, enabling participants to build their understanding step by step. In addition, the use of visual-based presentation media enhanced the effectiveness of learning, as it helped simplify complex concepts and increase participant engagement. This approach aligns with the concept of multimodal learning, which integrates visual elements, text, and interaction. The delivery of the material by the instructor to the participants during the activity is shown in Figure 2.



Figure 2. Delivery of Community Service Materials

In general, the learning materials covered fundamental concepts of halal and haram, critical control points of halal assurance in production processes, potential contamination, and halal certification procedures. The materials were delivered in a structured and gradual manner, allowing participants to build their understanding progressively from basic concepts to real-world applications. This approach is consistent with various halal training programs that systematically include both foundational knowledge and certification procedures (Huda *et al.,* 2023; Jufrinaldi *et al.,* 2025; Widyastuti *et al.,* 2025). Furthermore, the identification of halal critical points in production processes has been widely discussed across various food and biotechnology products (Atma *et al.,* 2017; Jannah & Mu'tamar, 2020), while the aspect of potential contamination is emphasized through hygiene standards in facilities and production processes (Marsiati *et al.,* 2022; Ulfin *et al.,* 2022).

In addition to the content, the use of presentation media as a visual aid also strengthened the effectiveness of the learning process. Visual elements such as diagrams, process flows, and case examples helped participants better understand complex and abstract concepts. This aligns with the multimodal learning approach, which emphasizes the integration of text, visuals, and interaction. Various studies have shown that visual media can enhance both understanding and learning motivation (Ekowati *et al.,* 2025; Maryati *et al.,* 2026), as well as develop students' visual and imaginative abilities (Kustandi *et al.,* 2021), although quantitative measurements of its effectiveness remain limited. The presentation media used in this activity are shown in Figure 3.



Figure 3. Presentation Media Display for Community Service Materials

In addition, the learning materials were designed contextually by considering the participants' background as agricultural vocational high school students. The examples provided were directly related to agricultural product processing, thereby increasing the relevance and connection between theory and

practice. This approach aligns with the principles of contextual teaching and learning, which emphasize learning based on real-life experiences.

This contextual approach becomes even more meaningful when linked to local regional potential. In the context of Riau, the use of examples based on coconut and palm oil processing not only enhances students' understanding but also strengthens their readiness to meet workforce demands in the halal agroindustry sector. Several studies have demonstrated the effectiveness of this approach, including improvements in cognitive mastery and affective aspects, as well as increased competence in the context of agricultural product processing (Winarsih, 2021). Furthermore, Fatimah & Solihah (2021) also emphasize that agriculture-based contextual teaching materials are effective in improving vocational high school students' understanding.

Thus, learning materials function not only as a source of information but also as an instrument for developing comprehensive understanding. The integration of systematic materials, supportive media, and interactive approaches becomes a key factor in explaining the improvement in participants' learning outcomes.

However, the results of the normalized gain (N-Gain) calculation show a value of 0.56, which falls into the moderate category. This finding indicates that the learning intervention was sufficiently effective in improving students' understanding, although it has not yet reached an optimal level of effectiveness. This condition suggests there is still room for improvement, which may be influenced by the limited duration of the intervention, the heterogeneity of participants' initial abilities, and the complexity of the material delivered.

Further analysis of the N-Gain distribution per student shows that the majority of participants were in the moderate category, total 16 students (64%), followed by the high category with 7 students (28%), and the low category with 2 students (8%). This distribution indicates that the effectiveness of the learning intervention has not been evenly achieved across all participants. The presence of a small number of students with low improvement highlights the need for greater attention to differences in initial abilities and the implementation of more adaptive learning strategies.

Overall, the applied learning intervention model is not only statistically effective but also provides a substantive impact on the quality of participants' understanding. This model is capable of integrating cognitive, contextual, and vocational aspects simultaneously, making it a promising innovative learning strategy in competency-based education, particularly in the field of halal agroindustry based on local potential. The final documentation of this community service activity is presented in Figure 4.



Figure 4. Final Documentation of Community Service Activities

Several factors are assumed to have influenced these outcomes, including the limited duration of the intervention, the heterogeneity of participants' initial abilities, and the complexity of the material

presented. In addition, limitations in the study design, such as the absence of a control group, should be taken into account when interpreting the results and generalizing the findings.

Considering these findings and limitations, further development is needed through a more comprehensive instructional design, longer intervention duration, and more adaptive approaches tailored to participants' characteristics. These efforts are expected to optimize the effectiveness of learning and expand the contribution of this learning model within the context of vocational education based on the halal agroindustry. In addition, program sustainability should be strengthened through follow-up mentoring, including practical implementation of the SJPH and potential assistance for halal certification of schools and associated MSMEs, supported by collaboration with BPJPH and LPH.

4. Conclusions

The educational program on halal food and halal certification conducted with students of SMKN Pertanian Terpadu Provinsi Riau proved to be effective in improving participants' understanding. This is evidenced by a significant increase between pretest and posttest scores, as well as the results of the paired sample t-test, which indicate a statistically significant difference. The N-Gain value, which falls into the moderate category, suggests that the learning intervention had a reasonably effective impact.

In addition to improvements in cognitive aspects, the learning process also promoted the development of higher order thinking skills (HOTS), particularly in understanding critical points of halal assurance, potential contamination, and halal certification procedures. Therefore, the contextual and practice-based learning approach applied in this program can serve as a relevant alternative learning model to enhance halal literacy and better prepare students to meet the demands of the halal industry. In terms of practical implications, vocational schools are encouraged to integrate SJPH-based training into their curriculum and collaborate with industry partners to provide hands-on experience in halal assurance practices. For industry stakeholders, this model can support the development of a workforce that is more competent in halal compliance. Furthermore, future research is recommended to involve larger and more diverse participant groups, apply a longer intervention period, and examine the long-term impact of the program on students' competencies and readiness to engage in the halal industry.

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6. Conflict of Interest Declaration

The authors declare that there is no conflict of interest regarding the publication of this article. The authors also confirm that this manuscript is original and free from plagiarism.

7. Author Contribution Statement

All authors contributed equally to the conduct community service project, data analysis, and writing and preparation of this article.

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