

Development of the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model for Poultry Slaughterhouse Operators to Promote Sustainable Wastewater Management in Makassar City

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Abstrack

Wastewater management in poultry slaughterhouses remains a major challenge in achieving sustainable business practices. A needs assessment involving 30 poultry slaughterhouse operators revealed that participants' knowledge of wastewater management was at a moderate level, while their attitudes toward implementing sustainable wastewater management practices were still low. These findings indicate the need for an educational model that not only enhances knowledge but also fosters positive attitudes and commitment toward environmentally sustainable wastewater management. This study aimed to develop the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model and evaluate its validity, practicality, and effectiveness. The study employed a Research and Development (R&D) approach based on the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The evaluation involved three expert validators, two observers, and poultry slaughterhouse operators participating in the training program. Data were collected using validation sheets, observation sheets, participant response questionnaires, knowledge tests, and attitude questionnaires through a one group pretest posttest design. The data were analyzed descriptively based on the aspects of validity, practicality, and effectiveness. The findings demonstrated that the ASIS Educational Model achieved a high level of validity according to expert evaluations and was considered highly practical based on the implementation of the learning syntax, instructor performance, and positive participant responses during the training. The model was also proven to be effective in improving participants' knowledge, with the mean score increasing from 0.36 (low category) to 0.75 (high category), and in improving participants' attitudes, with the mean score increasing from 2.22 (low category) to 3.68 (high category). These findings indicate that the ASIS Educational Model effectively enhances both the cognitive and affective competencies of poultry slaughterhouse operators in

sustainable wastewater management and has strong potential as an alternative educational model for capacity building programs in the agri food industry.

Keyword: ASIS Educational Model; Poultry Slaughterhouse; Sustainable Wastewater Management; Knowledge; Attitude.

I. Introduction

Poultry slaughterhouses (PSHs) constitute an essential component of the poultry food supply chain, playing a crucial role in ensuring the availability of products that are safe, wholesome, hygienic, and halal. As poultry meat consumption continues to increase, the number of small and medium scale poultry slaughterhouse enterprises has also grown, resulting in a corresponding increase in the volume of wastewater generated. Poultry slaughterhouse wastewater typically contains blood, fats, proteins, suspended solids, and high concentrations of organic matter, leading to elevated Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) levels when discharged without adequate treatment. Such conditions have the potential to degrade receiving water quality, contribute to environmental pollution, and pose significant risks to public health [1], [2].

Wastewater management remains a significant challenge among small scale poultry slaughterhouse enterprises in Indonesia, including those in Makassar City. Many operators continue to face limitations in implementing proper hygiene and sanitation practices, operating wastewater treatment plants (WWTPs), and adopting wastewater management practices that comply with environmental standards. However, the success of slaughterhouse wastewater management depends not only on the availability of appropriate treatment technologies but also on the competence of human resources to operate, maintain, and manage wastewater treatment systems in a sustainable manner [3].

A needs assessment conducted among 30 poultry slaughterhouse operators revealed that participants' knowledge of poultry slaughterhouse management was at a moderate level, whereas their attitudes toward implementing sustainable wastewater management remained low. These findings indicate that, although participants possessed basic knowledge of wastewater management, they had not yet translated this knowledge into positive attitudes and a strong commitment to sustainable environmental management. This gap between the cognitive and affective domains suggests that improving knowledge alone is insufficient to promote meaningful behavioral change. Previous studies in environmental education have likewise demonstrated that lasting behavioral change requires educational approaches that simultaneously enhance knowledge, foster positive attitudes, and strengthen participants' commitment to sustainable environmental practices [4], [5].

Previous studies have predominantly focused on the development of wastewater treatment technologies, the characterization of slaughterhouse wastewater, and the improvement of wastewater treatment plant (WWTP) efficiency in slaughterhouse operations [1], [2]. In contrast, studies focusing on the development of educational models specifically designed for poultry slaughterhouse operators remain limited. Existing training programs have generally emphasized the delivery of technical information and have not been developed as systematic instructional models or evaluated in terms of their validity, practicality, and effectiveness. This gap highlights the need for an educational model that not only enhances the competencies of poultry slaughterhouse operators but also fosters positive attitudes and a stronger commitment to sustainable wastewater management practices.

Based on these conditions, this study developed the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model using a Research and Development (R&D) approach based on the ADDIE framework. The ASIS model was designed according to the principles of adult learning and integrates four sequential learning stages: Attention, which captures learners' interest and awareness; Stimulation, which encourages critical thinking and active engagement; Improvement, which enhances participants' knowledge and practical skills; and Strengthen, which reinforces positive attitudes and long term commitment toward sustainable practices. The novelty of this study lies in the development of an educational model that integrates learning syntax, the social system, reaction principles, support systems, as well as instructional and nurturant effects into a comprehensive framework evaluated in terms of its validity, practicality, and effectiveness. Therefore, this study aims to produce an ASIS Educational Model that is valid, practical, and effective in improving the knowledge and attitudes of poultry slaughterhouse operators toward sustainable wastewater management.

II. Method

This study employed a Research and Development (R&D) approach to develop the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model aimed at improving the knowledge and attitudes of poultry slaughterhouse (PSH) operators toward sustainable wastewater management. The model was developed based on the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) framework, which provides a systematic process for designing, developing, implementing, and evaluating educational products [6]. This article focuses on the product evaluation stage by assessing three key quality criteria validity, practicality, and effectiveness in accordance with the educational product quality framework proposed by Plomp and Nieveen [7].

The study involved three expert validators who assessed the feasibility of the educational model, instructional materials, and research instruments; two observers who evaluated the implementation of the model and the instructor's performance during the training; and poultry slaughterhouse (PSH) operators who participated in the implementation phase of the model. Data were collected using validation sheets, model implementation observation sheets, instructor performance observation sheets, participant response questionnaires, knowledge tests, and attitude questionnaires. Participants' knowledge and attitudes were measured using a one group pretest posttest design to determine changes before and after the implementation of the ASIS Educational Model.

The data were analyzed descriptively by calculating the mean scores for each evaluation indicator. Validity was determined based on expert evaluations of the educational model, instructional materials, and research instruments. Practicality was assessed through the implementation fidelity of the model syntax, the instructor's performance, and participants' responses during the training program. Effectiveness was evaluated by comparing participants' pretest and posttest scores on the knowledge and attitude measures. This evaluation approach is consistent with the framework for educational design research, which states that a development product can be considered to be of high quality if it meets the criteria of validity, practicality, and effectiveness [7].

III. Result and Discussion

A. Result

This study resulted in the development of the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model, which was designed to enhance the knowledge and attitudes of poultry slaughterhouse

(PSH) operators toward environmentally sustainable wastewater management. The four learning stages were developed based on the principles of adult learning, emphasizing active participant engagement, the gradual development of knowledge and skills, and the reinforcement of commitment to achieving sustainable behavioral change.

The Attention stage serves as the initial phase of the ASIS Educational Model and is intended to capture participants' attention, stimulate their interest, and prepare them for the learning process. During this stage, the instructor presents real world phenomena, environmental issues surrounding poultry slaughterhouse (PSH) operations, and evidence of pollution resulting from inadequate wastewater management. The presentation of these contextual problems is expected to stimulate participants' curiosity and raise their awareness of the importance of sustainable wastewater management. The Stimulation stage aims to provide intellectual stimulation through group discussions, case study analyses, practical demonstrations, and the use of instructional media. At this stage, participants are encouraged to identify the causes of wastewater management problems, analyze their environmental and public health impacts, and relate their own experiences to the principles of proper wastewater management. This process is expected to enhance learning motivation while fostering participants' critical awareness of sustainable environmental practices. The Improvement stage represents the core of the learning process, focusing on enhancing participants' knowledge and practical skills. During this stage, the instructor delivers instructional content on wastewater management systems, wastewater treatment plants (WWTPs), operational procedures, and wastewater management practices that comply with environmental regulations. Participants are not merely passive recipients of information; they actively engage in discussions, practical exercises, and hands on activities, enabling them to develop a deeper and more applicable understanding of sustainable wastewater management. The final stage, Strengthen, is designed to reinforce participants' learning outcomes through reflection, constructive feedback, evaluative discussions, and the development of personal commitments to implementing sustainable wastewater management practices. This stage emphasizes the affective dimension of learning by strengthening participants' attitudes, motivation, and sense of responsibility. Consequently, participants are expected not only to understand the principles of wastewater management but also to demonstrate a sustained commitment to applying these principles in the daily operations of poultry slaughterhouses.

The ASIS Educational Model was evaluated through expert assessments conducted by three validators who reviewed the model components, instructional materials, and research instruments. This evaluation was intended to ensure that the developed model met both conceptual and operational feasibility requirements prior to its implementation in the training program. The results showed that all major components of the ASIS Educational Model achieved a high level of validity, indicating that the model is supported by a sound theoretical foundation, well designed instructional materials, and evaluation instruments that satisfy established quality standards.

The practicality of the ASIS Educational Model was further evaluated using three key indicators: the fidelity of the model implementation during training, the instructor's ability to manage the learning process, and participants' responses to the training program, as assessed by two independent observers. The findings demonstrated continuous improvement in both the implementation of the model and the instructor's performance across successive training sessions. These results indicate that all four stages of the ASIS model Attention, Stimulation, Improvement, and Strengthen were implemented consistently following refinements made after the initial evaluation, and that the instructor was able to effectively facilitate each stage according to the designed learning syntax. Participants' responses also showed

positive improvements, particularly regarding the clarity of the instructional content, the ease of understanding the training modules, the quality of interaction with the instructor, and the overall comfort and satisfaction experienced during the training. These findings suggest that the model is user friendly, well accepted by participants, and easy to implement. Overall, the results demonstrate that the ASIS Educational Model satisfies the criterion of practicality, as it can be implemented consistently, is readily applicable by instructors, and receives positive acceptance from training participants.

The effectiveness of the ASIS Educational Model was subsequently evaluated based on improvements in participants' knowledge and attitudes following their participation in the training program. Participants completed a pretest before the training and a posttest after completing all learning activities to measure changes attributable to the implementation of the model. The results of the descriptive analysis of the knowledge and attitudes of poultry slaughterhouse operators toward sustainable wastewater management are presented below.

Descriptive Analysis

The descriptive analysis of the pretest and posttest scores for each knowledge indicator is presented in the following table. The table summarizes the mean scores before and after the intervention, together with their corresponding interpretation categories based on the 0–1 scoring scale. This comparison provides a clear overview of the changes in participants' knowledge following their completion of all learning stages of the ASIS Educational Model.

Table 1. Descriptive Statistics of Sustainable Wastewater Management Knowledge among Poultry Slaughterhouse Operators

Training Module	Mean Pretest Score	Category	Mean Posttest Score	Category
Sustainable Poultry Slaughterhouse Operations	0.42	Moderate	0.77	High
Poultry Slaughterhouse Layout	0.44	Moderate	0.89	Very High
Poultry Slaughterhouse Wastewater Management	0.26	Low	0.69	High
Poultry Slaughterhouse Wastewater Treatment Plant (WWTP)	0.33	Low	0.63	High
Average	0.36	Low	0.75	Very High

The results of the descriptive analysis indicate that the participants' mean pretest knowledge score was 0.36, which falls within the low category. This finding suggests that, prior to the training, participants had limited knowledge of sustainable poultry slaughterhouse (PSH) operations, PSH layout, wastewater management, and wastewater treatment plant (WWTP) systems. Following the implementation of the ASIS Educational Model, the mean posttest knowledge score increased to 0.75, which is classified as high. The substantial improvement from 0.36 to 0.75 demonstrates that the ASIS Educational Model effectively enhanced participants' understanding of the training content. These findings indicate that the developed instructional model successfully facilitated the learning process, enabling participants to acquire a more comprehensive understanding of sustainable poultry slaughterhouse management and wastewater management practices.

The improvement in participants' knowledge observed in this study is consistent with recent evidence indicating that environmental education programs are more effective when they employ active, participatory, and contextual learning approaches. Such approaches encourage learners to actively engage in problem-solving, relate learning content to real-world environmental issues, and apply newly acquired knowledge in practical settings [8]. These instructional strategies have been shown to significantly improve environmental knowledge and strengthen learners' capacity to adopt sustainable environmental management practices. Furthermore, systematic reviews of environmental education have concluded that learner-centered instructional designs emphasizing active engagement, relevance, interaction, and reflection produce more meaningful learning outcomes and contribute to higher levels of environmental literacy than conventional knowledge-transmission approaches.

Following the analysis of participants' knowledge levels, a descriptive analysis was conducted on participants' attitude scores before and after the implementation of the ASIS Educational Model. This analysis aimed to determine the extent to which the learning program was able to foster participants' environmental awareness, commitment, and readiness to implement sustainable wastewater management practices in poultry slaughterhouse operations.

Table 2. Descriptive Statistics of Attitudes toward Sustainable Wastewater Management among Poultry Slaughterhouse Operators

Training Module	Mean Pretest Score	Category	Mean Posttest Score	Category
Sustainable Poultry Slaughterhouse Operations	2.30	Low	3.77	High
Poultry Slaughterhouse Layout	2.20	Low	3.68	High
Poultry Slaughterhouse Wastewater Management	2.17	Low	3.65	High
Poultry Slaughterhouse Wastewater Treatment Plant (WWTP)	2.22	Low	3.63	High
Average	2.22	Low	3.68	High

The results of the descriptive analysis indicate that the participants' mean pretest attitude score was 2.22, which falls within the low category. This finding suggests that, prior to the training, participants demonstrated relatively weak support for the implementation of sustainable poultry slaughterhouse (PSH) management practices, including the proper layout of slaughterhouse facilities, sustainable wastewater management, and the operation and utilization of wastewater treatment plants (WWTPs). Following the implementation of the ASIS Educational Model, the mean posttest attitude score increased to 3.68, which is classified as high. This substantial improvement indicates that the ASIS Educational Model was effective in fostering more positive attitudes toward the adoption of sustainable poultry slaughterhouse management practices. Furthermore, the findings demonstrate that the model not only enhanced participants' knowledge but also successfully promoted positive attitudes toward all key aspects of sustainable poultry slaughterhouse management.

The positive changes in participants' attitudes are consistent with recent studies demonstrating that environmental education programs incorporating active participation, experiential learning, and reflective activities are effective in fostering pro-environmental attitudes and strengthening individuals' commitment

to sustainable practices. Educational interventions that encourage learners to analyze real-world environmental problems, engage in collaborative discussions, and reflect on their responsibilities have been shown to produce meaningful changes in the affective domain, thereby increasing the likelihood of adopting environmentally responsible behaviors. Recent systematic reviews further emphasize that effective environmental education should address not only cognitive outcomes but also attitudes, values, and behavioral intentions, as these dimensions are fundamental to achieving long-term sustainability goals [9], [10].

B. Discussion

The findings of this study demonstrate that the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model satisfies the three fundamental quality criteria for educational design research, namely validity, practicality, and effectiveness. The successful performance of the model indicates that a systematically designed instructional approach can effectively enhance participants' knowledge while simultaneously fostering positive attitudes toward sustainable wastewater management among poultry slaughterhouse (PSH) operators. These findings are consistent with the bibliometric review conducted by Merritt [11], which concluded that environmental education innovations emphasizing active learner engagement represent one of the most effective strategies for improving environmental literacy and promoting sustainable waste management practices.

The high validity achieved by the ASIS Educational Model indicates that its learning syntax, social system, principles of reaction, support system, and instructional materials satisfy both conceptual and operational quality standards. This high level of validity suggests that the model was developed in accordance with the principles of adult learning, which emphasize learner experience, real world needs, and problem solving. Such an approach enables participants to more easily relate the training content to the practical challenges they encounter in managing wastewater at poultry slaughterhouses, thereby making the learning process more meaningful and relevant. These findings are consistent with previous studies demonstrating that contextual and experience based learning approaches are more effective in enhancing environmental literacy and improving learning outcomes than instructional methods that rely primarily on the passive delivery of information.

These findings are supported by recent studies emphasizing that educational models grounded in adult learning and experiential learning principles are more effective in promoting meaningful learning than traditional teacher-centered approaches [12], [13]. Learning activities that engage participants in authentic workplace problems, collaborative discussions, critical reflection, and practical experience enable adult learners to connect new knowledge with their prior experiences and professional responsibilities [13]. Such contextual learning environments not only improve knowledge acquisition but also strengthen learners' capacity to apply sustainable environmental management practices in real-world settings. Furthermore, environmental education programs incorporating experiential and participatory learning strategies have been shown to enhance environmental competencies, learner engagement, and long-term learning outcomes more effectively than approaches based primarily on one-way knowledge transmission [14].

The practicality of the ASIS Educational Model is demonstrated by the progressive improvement in the implementation of its learning stages, the instructor's ability to facilitate the training, and the positive responses provided by participants throughout the learning process. These findings indicate that each stage of the ASIS model can be implemented consistently and is readily understood by participants. The Attention stage effectively captured participants' interest and enhanced their learning motivation by

presenting real world cases of wastewater pollution associated with poultry slaughterhouse (PSH) operations. Subsequently, the Stimulation stage encouraged participants to engage in critical thinking through discussions, problem identification, and analyses of environmental impacts, resulting in greater active participation during the training. These findings are consistent with previous research showing that participatory learning strategies enhance learner engagement, strengthen learning motivation, and improve the effectiveness of environmental education by actively involving participants in the problem solving process.

The effectiveness of the ASIS Educational Model is reflected in the substantial improvement in participants' knowledge following the training program. The mean knowledge score increased from 0.36, categorized as low, to 0.75, categorized as high. This improvement demonstrates that the developed model effectively enhanced participants' understanding of sustainable poultry slaughterhouse (PSH) operations, PSH facility layout, wastewater management, and wastewater treatment plant (WWTP) systems. The observed increase in knowledge can be largely attributed to the Improvement stage, which emphasizes interactive discussions, demonstrations, practical exercises, and hands on activities, enabling participants to acquire deeper and more meaningful learning experiences. These findings support previous research indicating that environmental education programs integrating active learning, experiential learning, and field based practice have a greater impact on improving participants' knowledge than conventional lecture based instructional methods.

In addition to improving participants' knowledge, the ASIS Educational Model was also effective in enhancing their attitudes toward sustainable wastewater management. The mean attitude score increased from 2.22, categorized as low, to 3.68, categorized as high. These findings indicate that the learning process produced meaningful improvements not only in the cognitive domain but also in the affective domain. The positive change in participants' attitudes can be attributed to the Strengthen stage, which provides opportunities for reflection, constructive feedback, and the development of a personal commitment to implementing sustainable wastewater management practices in the workplace. Previous studies have consistently shown that environmental education programs integrating reflective learning, active participation, and commitment reinforcement are more effective in promoting long term behavioral change than approaches that focus solely on increasing knowledge.

Conceptually, the primary strength of the ASIS Educational Model lies in its integration of four sequential learning stages that facilitate a gradual process of change, beginning with capturing learners' attention (Attention), fostering critical awareness (Stimulation), enhancing knowledge and competencies (Improvement), and reinforcing commitment to sustainable practices (Strengthen). This integrated approach enables the learning process to produce not only improvements in participants' knowledge but also the development of positive attitudes that are essential for implementing sustainable wastewater management practices. This approach is consistent with the principles of Education for Sustainable Development (ESD), which emphasize that education should promote the development of knowledge, skills, values, and behaviors that support sustainable development.

Therefore, the findings of this study contribute to the advancement of environmental education models, particularly within the poultry slaughterhouse (PSH) sector. Unlike conventional training programs, which generally focus on the delivery of technical information, the ASIS Educational Model integrates attention, critical thinking stimulation, competency development, and commitment reinforcement into a single, systematic instructional framework. This integration enables participants not only to understand the principles of sustainable wastewater management but also to develop the readiness and commitment

required to consistently implement environmentally responsible wastewater management practices as part of broader sustainability efforts.

IV. Conclusion

This study successfully developed the ASIS (Attention, Stimulation, Improvement, Strengthen) Educational Model as an instructional framework to improve the knowledge and attitudes of poultry slaughterhouse (PSH) operators toward sustainable wastewater management. The model integrates four sequential learning stages Attention, Stimulation, Improvement, and Strengthen to facilitate a learner centered and progressive learning process. Through this structured approach, participants are guided from developing awareness and critical thinking to enhancing their competencies and reinforcing their commitment to sustainable wastewater management practices.

The evaluation results demonstrated that the ASIS Educational Model satisfies the three principal quality criteria for educational design research: validity, practicality, and effectiveness. The model achieved a high level of validity, as confirmed by expert evaluations of the model components, instructional materials, and research instruments. Its practicality was evidenced by the consistent implementation of the learning syntax, the instructor's effective management of the training process, and the positive responses from participants. Furthermore, the model proved to be effective, as reflected by the increase in participants' mean knowledge score from 0.36 to 0.75 and the improvement in their mean attitude score from 2.22 to 3.68 following the training.

These findings indicate that the ASIS Educational Model effectively enhances both the cognitive and affective competencies of poultry slaughterhouse operators in sustainable wastewater management. Accordingly, the model has strong potential to serve as an educational framework for capacity building programs targeting poultry slaughterhouse operators and other agri food industries facing similar wastewater management challenges, thereby supporting the broader implementation of sustainable environmental management practices.

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