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**P****reparation of Generic Skill Assesment (GSA) for Vocational High School Students in the Field of Refrigeration and Air Conditioning Engineering**

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# ABSTRACT

The evolving refrigeration and air conditioning engineering industry demands a workforce proficient in both technical and generic skills. Traditional competency assessment models often prioritize technical skills, leaving a gap in evaluating essential generic skills. This research introduces the Generic Skill Assessment (GSA) model, designed to holistically assess vocational school students in the refrigeration and air conditioning sector. Utilizing a mixed-methods approach, the study developed a GSA instrument validated by experts, achieving a reliability score of 0.75. Key generic skills identified include communication, teamwork, adaptability, and critical and creative thinking. The model effectively integrates these skills with technical competencies through comprehensive assessment indicators. Despite challenges such as limited academic studies, low teacher awareness of generic skills, and inadequate curriculum evaluation, the GSA model demonstrates significant positive impacts. With 83% of students well-prepared for the industry, the GSA model offers a balanced and robust framework for evaluating and enhancing students' readiness for the workforce.

**Keywords:** *Generic Skill Assessment, Vocational High School, Refrigeration and Air Conditioning Engineering*

# INTRODUCTION

Amid the dynamic developments of increasingly complex industries and fierce global competition, the demand for a workforce with skills relevant to market demands becomes ever more crucial. One sector that requires skilled labour is the refrigeration and air conditioning engineering industry. In this context, Vocational High Schools (SMK) play a vital role in preparing competent future workers to meet industry needs. Recognizing the importance of generic skills, or soft skills, alongside hard skills in preparing SMK students for the workforce, various efforts have been made to develop competency assessment models that provide a comprehensive view of students' readiness for the industry. One model garnering attention is the Generic Skill Assessment (GSA) model, specifically designed to measure students' generic skills within an industrial context.

The refrigeration and air conditioning engineering industry is continuously evolving, driven by increased awareness of the importance of energy efficiency and air quality across various applications, from commercial buildings to households. "The refrigeration and air conditioning engineering industry is one of the rapidly growing sectors, especially in countries experiencing significant economic growth." [1] In this industry, solid technical skills are paramount, including understanding refrigeration principles, temperature control, equipment maintenance, and technical problem-solving. However, generic skills are equally important. For instance, effective communication skills are essential when interacting with customers or team members, while problem-solving skills are critical in handling emergencies or complex repairs.

SMK has a crucial role in preparing future workers for the refrigeration and air conditioning industry. SMK is tasked not only with imparting the necessary technical knowledge and skills but also with developing essential generic skills for future career success. "SMK has the responsibility to produce graduates who are not only technically skilled but also capable of adapting to diverse and dynamic work environments." [2] Therefore, developing a competency assessment model that measures SMK students' readiness in both technical and generic aspects is vital. Although many competency assessment models have been developed, several limitations remain. For instance, some models tend to focus more on technical aspects than generic skills [3]. Additionally, there is a need for better adaptation of existing assessment models to reflect the specific context of the refrigeration and air conditioning industry.

Based on this background, this research aims to develop a Generic Skill Assessment (GSA) preparation model suitable for SMK students in the field of refrigeration and air conditioning engineering. This research will integrate aspects of generic and technical skills into a holistic and contextual assessment model. Research on generic skills in vocational education has advanced significantly in recent decades. Generic skills encompass various abilities such as communication, teamwork, work ethics, and problem-solving, which are essential for graduates' work readiness. Generic skills are crucial in the industry to enhance productivity and work efficiency [4]. A structured and systematic assessment approach could help measure generic skills more accurately [5]. The mixed-methods approach is also increasingly used as it allows for the collection of rich and in-depth data [6].

In the field of refrigeration and air conditioning engineering, research shows that technical skills must be balanced with generic skills to achieve optimal performance. Generic skills such as time management, communication, and teamwork are crucial in completing complex engineering projects. Implementing an effective generic skill assessment model requires careful planning and execution [7]. Validating the model through trials and user feedback is essential to ensure its relevance and applicability [8].

Despite the recognized importance of integrating generic skills into vocational training, there is a notable gap between the industry's need for these skills and the competencies possessed by SMK graduates. This research addresses this gap by developing a GSA model that not only comprehensively assesses generic skills but also facilitates the development of these skills among students. By employing a mixed-methods approach, this study aims to provide a holistic view of the proposed model's effectiveness, thereby contributing to both academic knowledge and practical applications in vocational education.

The novelty of this research lies in several key aspects:

1. **Contextual Integration:** Unlike existing models, the proposed GSA model is specifically tailored to the refrigeration and air conditioning engineering industry, ensuring that the assessment criteria are directly relevant to the unique demands of this sector.
2. **Balanced Skill Assessment:** This research emphasizes an equal focus on both technical and generic skills, addressing a common limitation in current competency models that often prioritize technical skills over generic ones.
3. **Comprehensive and Holistic Approach:** By adopting a mixed-methods approach, the research provides a more nuanced understanding of students' competencies, capturing both quantitative and qualitative data to inform the assessment model.
4. **Practical Applicability:** The model will be validated through trials and feedback from industry stakeholders, ensuring that it is not only theoretically sound but also practically relevant and useful for preparing students for real-world challenges.
5. **Gap Bridging:** This research explicitly aims to bridge the gap between the industry's need for generic skills and the skills currently possessed by SMK graduates, offering a solution that enhances the employability and effectiveness of vocational school graduates in the workforce.

Through these innovative contributions, the research advances the field of vocational education by providing a robust framework for assessing and developing the essential skills needed in a rapidly evolving industrial landscape.

# RESEARCH METHOD

The research methodology is designed to ensure the validity, reliability, and effectiveness of the proposed model. The study was conducted at SMK Negeri 1 Cimahi, focusing on the Refrigeration and Air Conditioning Engineering concentration, with a research population comprising teachers from this concentration and 33 students from class XI A. The research was carried out over three days, from date 20 to 22 May 2024. The chosen timeframe is expected to provide in-depth and representative data on the dynamics of teaching and interactions within class XI A. A well-planned research duration allows for more accurate and reliable data collection [9]. Thus, a three-day period is considered sufficient to achieve the research objectives. SMK Negeri 1 Cimahi, specifically its Refrigeration and Air Conditioning Engineering concentration, was chosen for its representativeness of the vocational education context in Indonesia.

The research subjects include teachers from the Refrigeration and Air Conditioning Engineering concentration at SMK Negeri 1 Cimahi, chosen for their critical role in the teaching and curriculum implementation process in this field. Involving teachers as research subjects aims to provide a deep understanding of teaching methods, challenges faced, and strategies used in this concentration. [10] The importance of selecting subjects relevant to the research objectives to obtain valid and reliable data. Teachers offer valuable insights into the dynamics and effectiveness of vocational classroom instruction.

The object of this research is the learning process and interactions in class XI A of the Refrigeration and Air Conditioning Engineering concentration at SMK Negeri 1 Cimahi. This class, consisting of 33 students, is chosen as it represents a sufficient sample of the student population in this concentration. Focusing on one class allows for detailed observations and comprehensive analysis of class dynamics, teacher-student interactions, and the implementation of the curriculum and teaching methods. [11] Selecting a specific research object helps obtain a detailed and focused picture, thereby contributing significantly to the development of educational practices in the technical field.

The research approach combines qualitative and quantitative methods. The qualitative approach aims to gain an in-depth understanding of industry needs and the generic skills expected from SMK graduates, while the quantitative approach measures the effectiveness of the GSA model in enhancing students' generic skills. [12] Qualitative methods provide rich insights into complex issues, whereas quantitative methods offer measurable data to support qualitative findings. The research design employs a mixed-methods approach, combining qualitative and quantitative elements. This study comprises two main stages: the development of the GSA model and its implementation and evaluation. During the development stage, qualitative data will be collected through interviews with industry experts, SMK teachers, and students to understand industry needs and essential generic skills. This data will inform the conceptual framework and assessment instruments for the GSA model. The implementation and evaluation stage involves applying the developed GSA model in several randomly selected SMKs. Quantitative data will be collected through surveys and practical tests to measure the model's effectiveness in enhancing students' generic skills. [13] Mixed methods approach provide a comprehensive understanding of the researched phenomena and yield stronger empirical findings.

The development phase of the GSA model includes a literature review, in-depth interviews with industry experts, SMK teachers, and students, qualitative data analysis using thematic analysis, development of a conceptual framework based on literature and interview findings, and model validation through focus group discussions with relevant stakeholders to ensure alignment with industry needs and practical applicability in SMKs. The implementation and evaluation phase involves applying the developed GSA model in selected SMKs, collecting initial quantitative data on students' generic skills levels before GSA implementation through surveys, conducting a series of learning and skill development activities according to the designed GSA model, collecting final quantitative data on students' generic skills post-GSA implementation through follow-up surveys, and analyzing the survey data using descriptive statistical techniques such as mean, median, and standard deviation to measure changes in students' generic skills before and after GSA implementation.

The research instruments include interview sheets designed to gather qualitative data on students' and teachers' views and experiences regarding the GSA model, questionnaires to collect quantitative data from SMK students on the effectiveness of the SMK “Siap Latih” program and generic skill assessments, and surveys to evaluate student and teacher perceptions and experiences with generic skill assessments at SMK. The combination of these instruments supports a mixed-methods approach, providing a comprehensive view of the effectiveness and challenges in implementing the GSA model in the Refrigeration and Air Conditioning Engineering field at SMK.

Data analysis is crucial for validating research findings and drawing strong conclusions [14]. Qualitative data from interviews with industry experts, SMK teachers, and students will be analyzed using thematic analysis, involving data coding, pattern identification, theme interpretation, and triangulation to ensure validity and reliability. Quantitative data from surveys and practical tests will be analyzed using descriptive statistics, processing survey data through statistical software, and employing descriptive statistical techniques to measure changes in students' generic skills before and after GSA implementation. Comparative analysis will be conducted between control and treatment groups to assess the GSA model's impact, with inferential statistical tests such as t-tests or ANOVA used as needed to test the significance of differences between groups. This combined qualitative and quantitative data analysis aims to provide a comprehensive understanding of the GSA model's implementation and effectiveness in enhancing generic skills among students in the Refrigeration and Air Conditioning Engineering field at SMK.

# RESULT AND DISCUSSION

The Generic Skill Assessment (GSA) was created to evaluate vocational high school students in refrigeration and air conditioning engineering on their generic skills essential for the workforce. These skills include effective communication, teamwork, critical thinking, and problem-solving abilities. [15] Student evaluation should consider knowledge, technical skills, and generic skills, which encompass communication, information delivery, logical thinking, independence, teamwork, and leadership.

The GSA instrument for vocational high school students in refrigeration and air conditioning engineering is detailed in the appendices and will be validated by expert judgment. The expert judgment deemed the instrument good and suitable for use, albeit with minor improvements based on expert feedback.

**Table 1.** Feedback and improvement from validator stakeholder

|  |  |  |
| --- | --- | --- |
| **No** | **Feedback** | **Improvement** |
| 1 | Add Occupational Safety and Health (OSH) to the GSA instrument. | The GSA design now includes OSH, covering (1) Preparation for OSH implementation, (2) Work adherence to SOPs, (3) understanding first aid (P3K) |

According to Azmi Rosyadi Salim, S.Pd., an industry stakeholder, the initial design should incorporate OSH aspects due to its importance in the workplace, which should be instilled during school education.

**Table 2.** Generic Skill Assessment (CSA) reliability test for vocational school students in the field of Refrigeration and Air Conditioning Engineering using SPSS 25.0

|  |
| --- |
| **Reliability Statistics** |
| **Cronbach’s Alpha** | **N of Items** |
| 750 | 3 |

Validity tests involved expert judgment from UPI’s Faculty of Technology and Vocational Education lecturers, productive teachers from SMKN 1 Cimahi, and PT MAS's director, experts in refrigeration and air conditioning. The instrument validation process indicated the assessment is suitable with revisions based on feedback, resulting in a reliable (consistent) assessment. Reliability testing, using SPSS version 25.0, yielded a Cronbach's alpha value of 0.750, indicating good reliability for the GSA instrument.

**Table 3.** Results Impact of implementation of GSA preparation model

|  |  |  |
| --- | --- | --- |
| **No** | **Number of Respondents** | **Impact Level** |
| 1 | 33 student | 83% |
| Total Average  | 83% |

Data from a questionnaire with 33 students showed an 83% impact rate, classified as good. This percentage represents the average score across various questionnaire aspects. The graph in Figure 4.1 illustrates the impact percentages for each aspect, confirming an overall positive impact of the GSA implementation.

**Figure. 1** Percentage graph for each impact questionnaire statement of implementation of the GSA preparation model

Preliminary studies involved interviews, observations, and documentation to gather data on GSA for vocational students in refrigeration and air conditioning engineering. Observations at SMKN 1 Cimahi from May 20-22, 2024, helped gather initial research data and develop the GSA design, later validated by experts. Key findings from interviews with productive teacher Asep Supriyatna, S.Pd. M.M., and PT. MAS Director Azmi Rosyadi Salim, S.Pd., identified the following essential generic skills:

1. Communication Skills: Effective interaction with teams and clients.
2. Teamwork Skills: Collaborative task-sharing and coordination.
3. Adaptability Skills: Adjusting to industry changes and challenges.
4. Critical and Creative Thinking Skills: Problem-solving and systematic thinking in refrigeration and air conditioning.

Integrating technical and generic skills involves combining relevant indicators from both skill sets. Interviews with Dr. Indra Mamad Gandidi, S.T. M.T., a lecturer in the Faculty of Technology and Vocational Education, highlighted essential technical and generic skills for integration:

1. Technical Skills: Operating, maintaining, and designing refrigeration and air conditioning systems, and integrating with other technologies.
2. Generic Skills: Effective communication, teamwork, critical and creative thinking, learning strategies, and adaptability.

The validated GSA instrument includes these indicators, allowing for comprehensive and effective assessment. Challenges identified through surveys, documentation, and interviews include a lack of academic studies linking SMK curricula with generic skills, low teacher awareness of GSA importance, insufficient curriculum evaluation, and issues during GSA model implementation. Despite these challenges, generic skills are essential for building SMK students' character, particularly in relation to work culture, attitudes, and values. Expert judgment categorized the GSA instrument as good and suitable, with some minor improvements. Azmi Rosyadi Salim, S.Pd., emphasized adding OSH aspects to the GSA instrument, reflecting the importance of OSH in both education and the workplace. [16] vocational education should align with workforce needs, including OSH concepts. Survey results indicated a good impact of the GSA model implementation, with an overall score of 83%.

Detailed breakdowns of each aspect show varying percentages, emphasizing areas like self-preparation, knowledge of generic skills, development of technical skills, effective communication, teamwork, problem-solving, independent work, and professional attitudes. Field studies identified essential generic skills: effective communication, teamwork, adaptability, and critical and creative thinking. These skills are crucial for interacting with teams and clients, achieving goals, adapting to industry changes, and solving problems in the refrigeration and air conditioning field.

According to Pool & Sewell [17] work readiness includes skills, knowledge, understanding, and personal attributes, contributing to students' overall competence and character development. Integration of technical and generic skills involves indicators that assess both skill sets, ensuring comprehensive evaluation. The validated GSA instrument covers technical competencies (such as equipment operation, maintenance, and system design) and generic skills (like communication, teamwork, critical thinking, and adaptability), providing a holistic assessment approach. Identified challenges include the lack of academic research on SMK curriculum and generic skills, low teacher awareness of GSA, insufficient curriculum evaluation, and issues during implementation. Despite these obstacles, generic skills are vital for shaping SMK students' character and work ethics. Work is a fundamental human activity, and improving work culture, values, and generic skills can significantly influence SMK students' overall character and the quality of the Indonesian workforce.

**CONCLUSION**

Based on the research on the preparation model of the Generic Skill Assessment (GSA) for vocational high school (SMK) students in the field of refrigeration and air conditioning, the following conclusions can be drawn: A design for the Generic Skill Assessment (GSA) instrument for SMK students in the field of refrigeration and air conditioning has been created and evaluated through expert judgment by SMK teachers, lecturers from the Faculty of Technology and Vocational Education, and industry stakeholders. The instrument has been deemed valid and reliable, with a reliability score of 0.75, indicating that the GSA model is suitable and effective for assessing generic skills.

The generic skills considered important for SMK students to face challenges in the refrigeration and air conditioning industry include communication skills, teamwork skills, adaptability skills, and critical and creative thinking skills. The integration of technical and generic skills can be effectively carried out in a competency assessment model for SMK students in the field of refrigeration and air conditioning through the GSA, which includes indicators for both technical and generic skills.

Challenges encountered in the development and implementation of the GSA model in the context of vocational education for refrigeration and air conditioning include a lack of academic studies on the link between the SMK curriculum and generic skills, insufficient teacher awareness of the importance of developing Generic Skill Assessments, inadequate curriculum evaluation, and issues with students consulting peers when completing questionnaires. The impact of implementing the GSA model on SMK students' preparation for entering the workforce in the refrigeration and air conditioning industry is categorized as good, with a percentage score of 83%.

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