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Research Article

ISCO-Based Analysis of Internship Activities as a Basis for the Development of Sustainable Automotive Vocational Skills

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ABSTRACT

Purpose of the study: Internship activities can serve as a reference for the skills vocational education institutions require to produce competent graduates. By analyzing internship activities by International Standard Classification of Occupations (ISCO) skill level, the aim is to create a mapping of automotive skills.

Methodology: A qualitative approach was employed to analyze 15 internship documents, including activity notes and reports validated by industry experts. The interview participants, selected using purposive sampling, consisted of 5 vocational internship supervisors. The analysis process included data collection, reduction, coding, data triangulation, and interpretation, using NVivo 12.

Main Findings: The research results indicate that the foundational competencies in automotive include ISCO 1 skills in terms of work ability and the maturity of soft skills related to the job. The demand for hard skills is driven by jobs equivalent to ISCO skill levels 2; however, higher-level skills, namely ISCO levels 3 and 4, are also required for jobs involving advanced thinking and decision-making in the automotive after-sales industry. Document analysis results reveal the types of skills vocational education institutions can prepare students to engage with, including simulation-based learning, project-based learning, problem-based learning, and work-based learning.

Novelty/Originality of this study: Ultimately, this study demonstrates sustainable skill mapping based on job types and ISCO skill levels at low cost through systematic, integrative steps, leveraging the potential of annual industrial internship activities and serving as a reference for other professional competencies.

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1. INTRODUCTION

Skill development is a crucial step that vocational education must achieve through educational and training efforts. The failure of these efforts causes industries to struggle in utilizing the potential of young generations to work in dynamic environments [1]. The implementation of vocational education, which refers to direct conditions, can be observed through industry internship programs that strengthen professional skills, including expertise, soft skills, and work attitudes [2], [3]. The results of a quality industrial internship program can enhance students' confidence in working in their respective fields [4]. Moreover, students who have this experience have a greater chance of being invited to job interviews and building relationships [5], [6], as they already have work experience in an industry relevant to their field [7]. Through the internship program, vocational education institutions can identify skill gaps [8] because the process involves the dedication of interns, the active involvement of supervising teachers, and the role of the school curriculum [8]-[10].

The gaps currently occurring include weak employability skills that are essential for every industrial sector [11]. The gaps in employability skills, particularly in terms of soft skills, include a lack of interpersonal communication abilities, fluency in foreign languages, effective time management, and problem-solving skills [1]. Learning designed to internalize work-related soft skills can address the gaps in transversal competencies in applied sciences, in line with the demands of the Industry 4.0 revolution, which increasingly emphasizes creativity, problem-solving abilities, and understanding digital systems in the workplace [12], [13]. The development in the global automotive sector involves not only mechanical systems but also the integration with electronic systems and software, thus requiring graduates who are skilled across a broad domain [14]. Therefore, the development of these skills requires support from curriculum adjustments, standardized reporting frameworks, impact assessments, and global collaboration [15]. The standard mapping of job levels in response to these developments needs to be aligned with the global standards of the International Standard Classification of Occupations (ISCO) skill levels, serving as a basis for adjusting standardized job difficulty levels [16].

The design of skill development tailored to ISCO skill levels must also consider the limitations due to technological conditions and the ability to meet current and future needs [17]. The role of industry in this regard is vital as an open innovation collaborator for sharing knowledge and new technologies [18]. Meanwhile, educational institutions must be more proactive in preparing students to meet industry requirements, as measured by ISCO skill levels, in order to better address workforce needs. The relationship between industry and the educational sector, as observed in the research by Muddle et al. [19], will lead to student competencies aligning with those of industry practitioners, making them more prepared to apply these skills in the real world. This indicates that the mismatch condition occurs due to not keeping up with field developments, inadequately measured training structures, an aging population structure, and the absence of long-term cooperation mechanisms [20], [21]. This situation requires adequate regulatory support and funding [15]; however, this can sometimes become an obstacle that must be overcome to achieve effective education in developing countries [22].

Techniques for bridging the skills gap, as carried out by Braun, Greta et al. [23], include actions such as data collection by utilizing the functions of documents or activity reports obtained from empirical experiences, such as industrial internships. This program can serve as a holistic approach to enhancing the quality of sustainable skill development by focusing on the industry framework and the skills gap of learners [21]. Training developed based on previous internship experiences has been proven to have a positive effect on improving the outcomes of subsequent groups [24]. However, research on mapping job difficulty levels in the automotive sector based on ISCO skill levels remains limited, making this a novel approach to mapping skill requirements according to jobs in the relevant industry.

. Mapping industry skill needs can use digital footprint data covering topics that frequently appear in discussions or job offers on digital platforms, or through review research [25]-[27]. Alternatively, it can utilize reviews of many text documents as a basis for mapping the skills required in the field [28]. Research by Pino Tarago et al. [13] also uses document analysis techniques to address the gap between graduates and the curriculum used in a developing country. This technique was previously used by Finch & Crunkilton [29] by analyzing industry activities to formulate a curriculum relevant to the field. Additionally, the use of this technique can be a solution to the problem of high vocational education costs and the dynamics of rapidly changing skill demands [30]. This analytical technique enables the analysis of industrial internship activities in alignment with competency frameworks and ISCO skill levels, as outlined in ISCO-08 [16], facilitating continuous skill development. Consequently, the results of this study can be compared with global skill requirements in the automotive after-sales industry.

This research is essential to conduct because the development of vocational automotive skills according to job level types will support customer satisfaction [31] in terms of service handling time, service quality, and service processes [32]. This is the reason why it is necessary to improve technical quality and repair processes to make after-sales services more cost- and time-efficient [33]. The steps needed to improve service quality include enhancing the quality of human resources, which vocational educational institutions must prepare to do. Therefore, this research aims to map sustainable vocational automotive skills based on ISCO skill levels through an analysis of industrial internship activities, which can help minimize the costs of implementing vocational education as part of updating dynamic automotive learning content in line with technological developments in the field. The findings in this research will answer questions related to 1) How are industry internship activities analyzed for their suitability based on ISCO skill levels? and 2) What sustainable skills are required in the automotive vocational, based on the results of this analysis?

2. RESEARCH METHOD

This study uses a descriptive qualitative approach based on document analysis to examine automotive vocational skills through internship activities lasting 3 to 6 months, thereby providing an overview of the typical work accepted by the industry. The industrial internship activities originate from 15 after-sales industries, comprising 6 large-scale general workshops and 9 official or authorized dealer workshops from 6 cities/regencies in Central Java Province, Indonesia. These workshop categories were chosen because they represent the latest technology and the implementation of well-structured operational work standards in serving customers, making them suitable for systematic learning.

The research data were collected from samples taken from the automotive vocational education community, selected using purposive sampling techniques, consisting of 15 internship participant documents (from students and vocational high school students) and 5 vocational internship mentor teachers from 4 vocational high schools in Central Java. Data sources include: 1) internship activity record documents; 2) internship reports validated by the relevant industry; 3) interview transcripts with internship mentor teachers; 4) transcripts of ISCO skill level analysis; and 5) articles on relevant contextual learning models. During interviews with mentor teachers, the researcher acted as the main instrument, referring to the interview indicators listed in Table 1, to enrich the data obtained from other sources.

Table 1. Interview Indicator

Aspect	Indicator
Implementation of industrial internship activities	Internship duration has the potential to become a pre-employment placement [34]
Work activities received Task execution by mechanics/interns	Skills required by the industry [21]
Learning implementation	Skills provided by vocational education institutions [21]

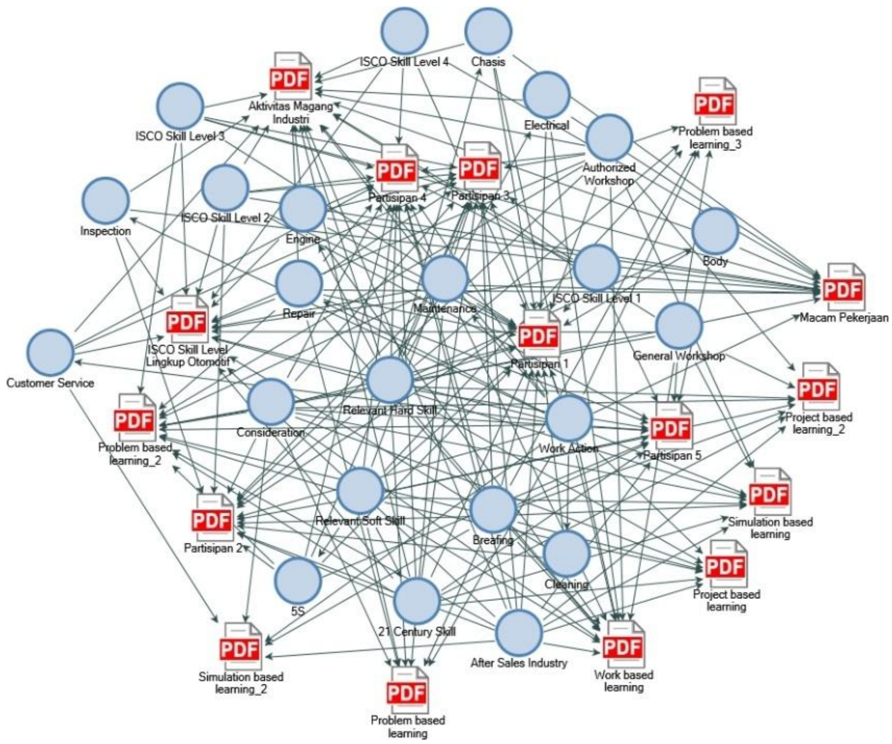

Figure 1. The Relationship Between Coding and Data

3. RESULTS AND DISCUSSION

Analysis of industrial internship activities

The implementation of internships in the after-sales industry, which is divided into official or authorized workshops and large-scale general workshops [35], has uniform job characteristics that can be used as a reference for continuous skill development strategies. This uniformity can be analyzed for its difficulty level using the ISCO skill level, so that the job level can be identified as a preparatory step to meet the competency needs in the automotive after-sales industry [16].

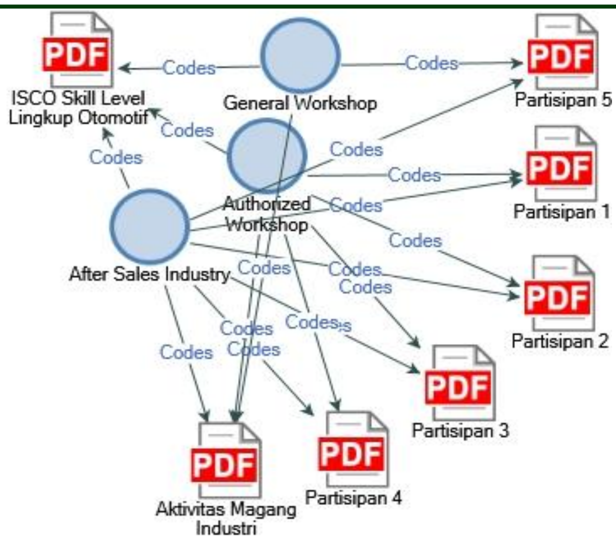

Figure 2. The Relationship Between Code and Data

According to information from research participants, jobs in the after-sales industry have uniformity in the process from unit acceptance to handover to the customer. According to participant 5, the steps for handling maintenance or car repair services include the following steps: “The car enters and is received by the receptionist, received by the service advisor (SA), unit inspection, work order creation, handed over to the workshop head, work forwarded to the team leader, mechanic carries out the work according to the work order, work results checked by the team leader, then handed over to the workshop head, car returned to the SA, car delivered to the customer, and warranty provided.” Similarly, participant 2 stated that: “Customer car enters, received by the frontman for inspection, work order creation, job distribution to mechanics, reporting back to the frontman, inspection of work results, handover to the customer, completion of administration.”

The work steps indicate that tasks are handled through a structured work system [36], where each section is responsible for its respective portion of the work. This indicates that the work character in this industry requires high discipline and responsibility from the moment an order is received until it is returned to the customer [36], to minimize production errors [37] and increase work productivity [38]. The competence of each work section can be detected in relation to the minor groups standardized by the International Labor Office.

Table 2. Relevance of Minor Group in the After-Sales Industry

Minor Group	Unit Group	ISCO Skill Level
Engineering professional	Mechanical engineering	4
Physical and Engineering Science Technician	Mechanical engineering technician	3
Client Information Worker	Receptionist	2
Material Recording and Transport Clerks	Stok clerks	2
Other sales worker	Sales demonstrator	2
Machine mechanic and repairs	Motor vehicle mechanic and repair	2
Metal processing and finishing plant operators	Metal finishing, planting, and coating machine operators	2
Assemblers	Mechanical machinery assemblers	2
Vehicle, window, Laundry, and Other Hand Cleaning Workers	Vehicle Cleaner	1

Table 2 presents a list of minor groups that have task relevance to jobs in the after-sales industry based on the coding relationships in Figure 4. This data visualization more clearly captures the industry culture encompassing jobs with ISCO Skill levels 1 to 4, which require mastery of hard and soft skills. Both are inseparable and have different proportions of discussion in this study, as they mutually support each other in delivering quality services in the after-sales industry.

Figure 3. After-Sales Industry

Figure 3 clarifies the relationship between the two aspects, showing that hard skills have a larger portion of discussion than soft skills. However, interviews with vocational school teachers revealed that soft skills are the primary need before vocational students undertake internships. Participant 2 stated: “Yesterday in the discussion forum, several points were conveyed, one of which was that the criteria for students entering Nasmoco are that they must be physically healthy, have the enthusiasm or motivation to learn, and possess soft skills. Hard skills, on the other hand, are considered secondary.” Participant 1 also expressed similar views, reinforcing the character and the foundational need for soft skills in the automotive after-sales industry. Participant 1 mentioned, “Official workshops emphasize students' soft skills; official workshops implement SOPs in their work. Official workshops consider students' discipline and skills as basic references for the readiness of students to carry out internships.” The emphasis is lower for intern participants at the university level, who are more focused on improving hard skills, as they generally learn with more mature preparedness compared to vocational high school students. This condition makes the hard skills aspect more frequently discussed in this study, as the emphasis on strengthening soft skills is more often conveyed through interviews with vocational high school teachers.

The aspect of hard skills plays an important role in the smooth running of business in the after-sales industry because it aligns with the purpose of carrying out maintenance and repair activities on automotive units [33], which are included in the job desk of machinery mechanic and repair at ISCO Skill Level 2 [16]. This finding is in line with the data visualization in Figures 4, which show that the ISCO Skill Level 2 coding section is more frequently found compared to other levels in the data sources of this study.

	ISCO Skill Level 1	ISCO Skill Level 2	ISCO Skill Level 3	ISCO Skill Level 4
Body	17.79%	73.62%	8.59%	0%
Chasis	2.82%	77.97%	18.64%	0.56%
Electrical	0%	49.7%	26.63%	23.67%
Engine	13.9%	45.75%	24.97%	15.38%
21 Century Skill	14.37%	21.86%	62.35%	1.42%
5S	41%	0%	59%	0%
Cleaning	62.03%	37.97%	0%	0%
Customer Service	0%	29.17%	67.71%	3.13%
Inspection	8.41%	52.1%	36.25%	3.24%
Maintenance	7.19%	53.94%	30.32%	8.55%
Management	0%	40%	50%	10%
Repair	8.3%	38.96%	40.86%	11.88%

Figure 4. Matrix Coding and Word Cloud ISCO Skill Level

The most frequently encountered verbs from field data also fall under the occupation of machinery mechanics and repair at ISCO skill level 2, which can be mastered after completing secondary vocational education, job training, and work experience [16]. These findings are reinforced by interviews with participants 1 to 4, who stated that the most common task is routine maintenance. However, Figures 4 show other ISCO skill levels within the after-sales industry, as indicated by the analysis of internship activity documents. The results reveal that work in the after-sales sector encompasses technical tasks related to product maintenance and repair, as well as opportunities to learn non-technical skills such as service scheduling management, customer service, spare parts data management, insurance claims, and service reporting.

Table 3. Coverage of Accepted Internship Jobs

		Vocational Higher Education	Vocational High School
Work often series		Periodic service, tune-up, repair/diagnosis/troubleshooting, spare part replacement, management	Periodic service
Internship placement unit	The highest frequency	Mechanical technician department	Mechanical technician department
	Rare frequency	Administrative and management department	-
Verbs in daily activity notes	The highest frequency	Servicing, maintaining, replacing	Replacing; checking/inspecting; filling; cleaning;
	Moderate frequency	Repairing, troubleshooting/diagnosing, adjusting, installing, turning	Pumping, installing/removing;
	Rare frequency	Managing, recording, reporting, handling, serving, documenting, dismantling/overhaul	Dismantling/overhaul

	Work Action	Cleaning	Customer Service	Inspection	Maintenance	Manajemen	Repair
Relevant Hard Skill	27.25%	0%	24.27%	31.96%	27.06%	50%	29.54%
Body	3.52%	0%	3.24%	8.68%	2.63%	0%	4.28%
Chasis	12.91%	0%	3.24%	26.48%	18.87%	0%	14.73%
Electrical	6.45%	0%	3.24%	10.05%	7.74%	0%	6.33%
Engine	13.51%	0%	15.21%	20.55%	18.56%	0%	14.09%
Relevant Soft Skill	18.56%	33.33%	11.97%	0%	9.75%	0%	13.25%
21 Century Skill	13.31%	33.33%	26.86%	2.28%	9.57%	50%	14.01%
5S	4.5%	33.33%	11.97%	0%	5.83%	0%	3.76%

Figure 5. Matrix Coding Work Action – Relevant Hard Skills and Soft Skills

The coding work action that interprets internship coverage data is related to coding-relevant hard skills and coding-relevant soft skills required in the after-sales industry. The data in Figure 5 indicates that technical job types, including maintenance, inspection, and repair, strongly relate to coding-relevant hard skills. Meanwhile, non-technical jobs like cleaning, customer service, and management relate to coding-relevant soft skills, 21st-century skills, and 5S. This condition becomes a consideration for the competencies of students who will continue their careers in the automotive after-sales industry sector.

Effective skills development is part of improving curriculum quality, which can map achievement standards from beginner to expert [39]. The results can support the synchronization of skills according to technological developments in the field [40], [41], serving as a reference for the development of competency content and learning strategies to prepare students for entering the workforce [3]. However, its implementation requires student learning readiness and adequate infrastructure support as a foundation for innovative learning. Participant 2 stated: "So, for the models of learning that are less extensive, like troubleshooting, they are usually only applied to children who are preparing for contests." In addition, considerations of infrastructure support are also essential to realize the relevance of learning. The lack of relevance in learning media is indicated by the results of interviews with participants 1-4, showing that students encounter new tools and the latest technology in automotive products, in addition to the work culture they experience. These points serve as considerations in the research, as a basis for conducting a more in-depth analysis related to the development of sustainable skills through a contextually appropriate learning process.

Table 4. Matrix Coding Code Consideration

	Consideration
After-sales Industry	7.34%
Authorized Workshop	6.43%
Breafing	23.96%
General Workshop	3.5%
ISCO Skill Level 1	0.57%
ISCO Skill Level 2	1.64%
ISCO Skill Level 3	3.73%
ISCO Skill Level 4	0.19%
Relevant Hard Skill	12.92%
Body	0.12%
Chasis	0.12%
Electrical	0.12%
Engine	0.83%
Relevant Soft Skill	18.07%
Work Action	11.28%
21st Century Skill	7.42%
5S	1.73%

Table 4 shows that the coding consideration overlaps or co-occurs with 17 other codings, indicating a relationship between codings. However, in the coding of briefing, relevant hard skills, relevant soft skills, and work action, they show a higher correlation percentage. These codings were analyzed for their correlation using Jaccard's coefficient, as shown in Table 5, where the relationship between the coding consideration and others is evident. Nevertheless, the list of codings in Table 4 is considered as data collection for adjusting the learning model to be used.

Table 5. Summary of Code Consideration Relationships

Code A	Code B	Jaccard's coefficient
Codes\\Consideration	Codes\\Breafing	0.531968
Codes\\Relevant Soft Skill	Codes\\Consideration	0.416565
Codes\\Relevant Hard Skill	Codes\\Consideration	0.344681
Codes\\Work Action	Codes\\Consideration	0.3

The five codes above in Table 5 include work data and tasks received during industrial internships, which are related to and supported by the other four Codes. These serve as a foundation for developing skill development strategies that align with the latest field conditions [29]. Table 4 shows the strongest relationship between the consideration Code, which signifies the mapping considerations of the learning model, and the briefing Code, which relates to the preparation required for students according to the needs of the automotive after-sales industry.

Figure 6. Word Cloud Coding Consideration and Breafing

Tabel 6. Word Count

Word	Length	Count	Weighted percentage (%)
Learning	8	55	2.04
Pekerjaan (Job)	9	40	1.49
Skills	6	30	1.11
Students	8	28	1.04

The portrait of the automotive after-sales industry conditions contains several most frequently used words, including learning, work, skills, and students, alongside other words. A review of the word "learning" shows its association with active learning, learning-based, learning media, learning management, learning environment, and transformative learning. A review of the word "job" shows its association with the most challenging jobs, the most frequently received jobs, and the easiest jobs. A review of the word "skills" shows its association with practical, essential, problem-solving, and communication skills. A review of the word "student" shows its association with student collaboration. These four words become child Codes that support the codes of consideration and briefing, thus enriching the relationships among codes in this study.

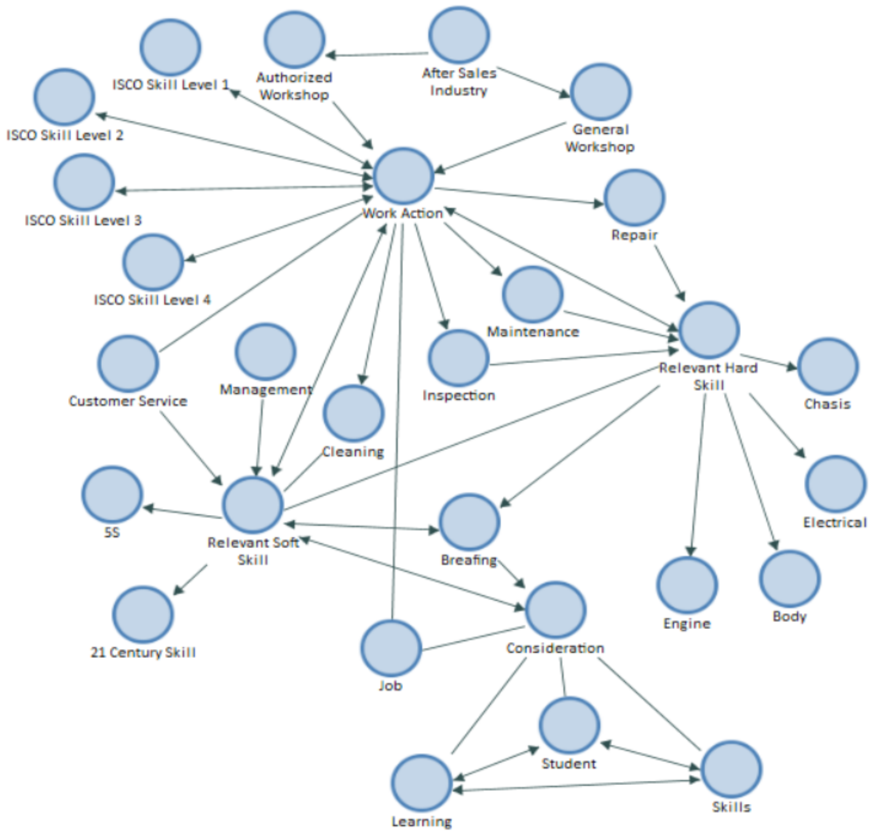

Figure 7. Relationships Between Codes

Analysis of skills and development of required skills

The automotive after-sales industry, which consists of authorized official and general workshops [35], handles technical and non-technical tasks classified according to ISCO Skill Level 1-4, as shown in Table 2. These job levels serve as qualifiers for job difficulty, education level, and skill capital required to perform tasks in the industry [42]. Among the various jobs depicted in Figure 4, the data show that most tasks are equivalent to skill level 2 in terms of hard skills. The findings indicate that students, both at the university and vocational high school levels, mostly gain experience as machinery mechanics and repair workers. Specifically, university student interns gain broader learning experiences, including those in non-technical areas, although this occurs only with minor frequency.

Level 2 skill jobs are closely related to technical work that involves inspection and maintenance across all automotive sections. In contrast, non-technical customer service and management jobs are more associated with level 3 skills. These technical and non-technical jobs demonstrate a connection with skill levels 2-3. This is because job codes do not correlate more than these two levels. This situation aligns with Balinado et al [43] and Abbas et al.'s [44] research, which states that the after-sales industry is a service provider that includes both technical and non-technical work.

However, Figure 4 shows that automotive electrical work correlates most significantly with ISCO coding skill level 4. Jobs in this area require critical thinking, making them unsuitable for workers with skill level 1, and are more appropriate for workers with skill levels 2-4. This does not exclude skill level 1 jobs, as aspects of cleaning and implementing the 5S work culture are closely related to this level, making these tasks foundational for all workers with higher skill levels. Another supporting foundation is mastery of 21st-century skills to enhance work productivity, inspection/quality control results, and the accuracy of corrective actions/troubleshooting of automotive products.

This means that work in the automotive after-sales industry can be done properly if workers possess relevant soft and hard skills. These skills need to be internalized by students through higher education institutions or vocational high schools (VHS), which provide skill level 1, and are more suitable for structured learning scenarios that cover the achievement of skill levels 1 through 4. In preparing these scenarios, considerations based on the analysis of internship activity data are required to present impactful training. Figure 7 illustrates the relationship between briefing coding and relevant skill coding. This implies that the success of training requires a foundation of appropriate soft skills that the students possess. Likewise, the success of soft skills applied in the workplace is influenced by the quality of training students receive from their educational institutions. The skills content taught during the training refers to relevant complex skill analysis data obtained from research source documents.

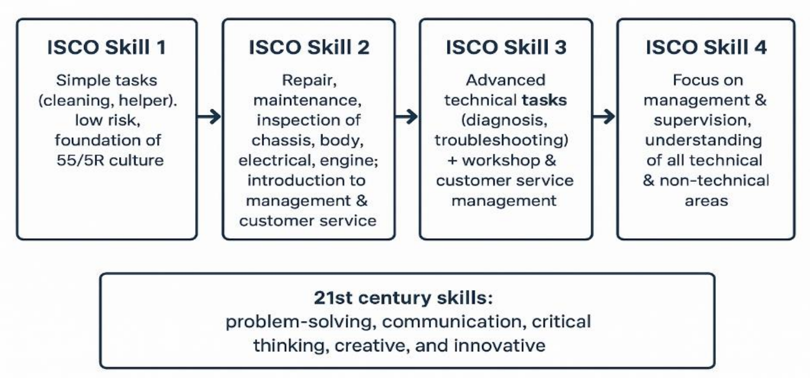

Figure 8. Continuous Skills Development Scenario

The considerations used to produce sustainable skill development consider aspects such as the types of jobs accepted, appropriate learning models, and the learners. In a sustainable skill development scenario, learners must have a strong foundation equivalent to ISCO skill level 1, such as cleaning, helpers, and other low-risk and straightforward jobs, by habituating the implementation of the 5S/5R work culture. Subsequently, learners are trained to master technical work equivalent to ISCO skill level 2, enabling them to handle repair, maintenance, and inspection of automotive products' chassis, body, electrical, and machine parts. In addition, they are also introduced to management knowledge and customer service. Next, students are trained to delve into non-technical work equivalent to ISCO skill level 3 to strengthen management knowledge and customer service skills, while still maintaining proficiency in technical tasks, including diagnosis and troubleshooting, so they can be relied upon to make technical and non-technical decisions. Subsequently, students master ISCO skill level 4, where the focus on handling technical and non-technical work diminishes. However, they have a well-rounded understanding of all tasks to perform control functions and improvements.

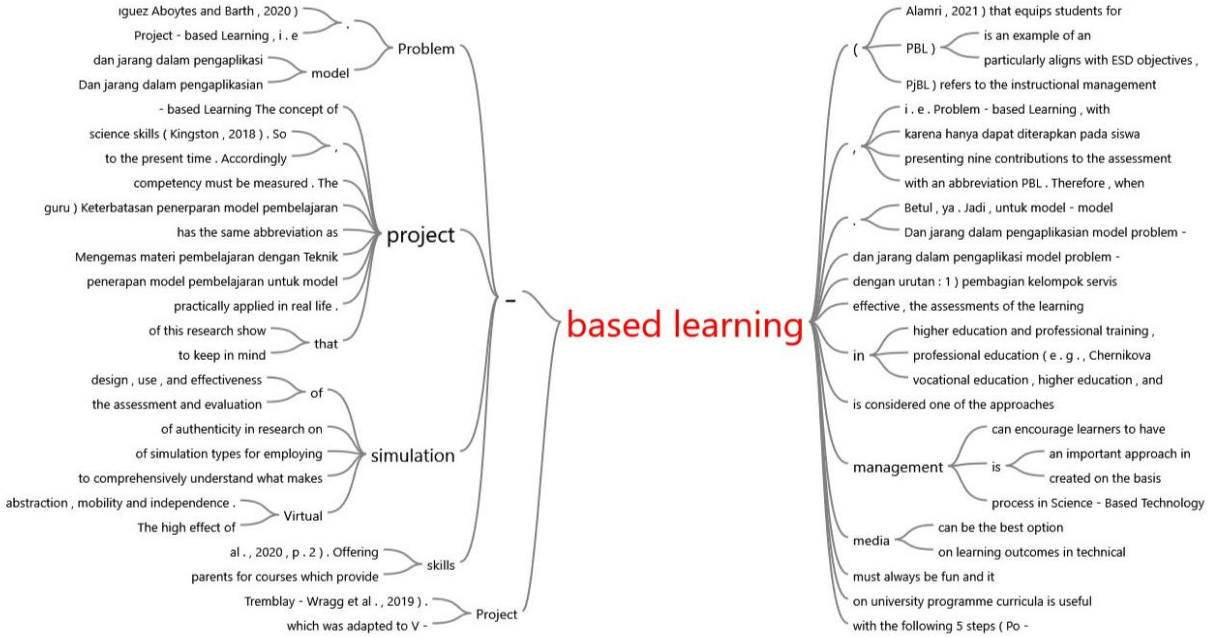

Figure 9. Text Search Query Learning

The learning models used in developing skills for a career in the after-sales industry can be identified from the text search query learning analysis results. The results are shown in Figure 9, which features several learning models according to job characteristics and the after-sales industry environment, including project-based learning [45], [46], problem-based learning [47]-[49], simulation-based learning [50], [51], and work-based learning [52]. These four learning models are related to coding consideration, briefing, relevant hard skills, and relevant soft skills. This relationship reinforces that these four learning models can shape the development of competent prospective employees' skills to produce cost- and time-efficient after-sales services [33], [32].

	Breafing	Consideration	Relevant Hard Skill	Relevant Soft Skill
Problem based learning	2.95%	17.01%	6.43%	3.32%
Problem based learning_2	16.35%	22.12%	24.02%	23.89%
Problem based learning_3	6.04%	0%	4.14%	0.78%
Project based learning	20.88%	13.84%	10.48%	13.76%
Project based learning_2	22.89%	21.32%	9.32%	23.36%
Simulation based learning	14.33%	11.86%	21.97%	18.45%
Simulation based learning_2	4.26%	8.35%	0%	0%
Work based learning	12.29%	5.49%	23.65%	16.44%

Figure 10. Learning Data Model Matrix

Figure 10 shows that the problem-based learning (PBL) model [47]-[49] is most closely associated with coding-related hard skills, whereas the project-based learning model [45], [46] is most closely related to developing relevant soft skills. The simulation-based learning model [50], [51] and work-based learning [52] should also be considered, as they are associated with coding-related hard skills and soft skills. Using these learning models enables them to support continuous skills development, achieving ISCO skill levels 1-4 in the automotive after-sales industry. PBL model offers high-quality teaching through the active involvement of students in solving problems, working in teams, and applying knowledge to real-life situations [53]. Such a culture can impact the development of critical thinking skills [54], [55]needed to support diagnostic and troubleshooting tasks. The use of the Project-Based Learning model, combined with worksheets that provide clear instructions [56], can support a learning culture that aligns with the work culture in the automotive after-sales industry, serving as a work simulation that references customer work order sheets.

The learning model choices obtained from this process address the study by Alam et al [1] to bridge the skills gap. These choices were obtained through a systematic analysis of authentic data using NVivo software to determine their alignment with the ISCO skill level standards, thus providing new insights from previous research as a solution to the dynamics of workforce skill needs. These findings have implications for vocational practitioners, indicating that competency content development can be carried out continuously by utilizing data from relevant ongoing activities, allowing the dynamics of technological development to be followed. However, this study interprets the results of the analysis of the automotive aftermarket industry based on data from this research. Therefore, these findings have not yet been extended to similar industries in other urban areas or to other types of industries within the automotive sector. The findings of this study require further validation using a quantitative approach to confirm the effectiveness of the chosen learning model and the relevance of the identified patterns to the automotive work environment. These recommendations are expected to enhance contributions to the improvement of sustainable skill development quality in accordance with field dynamics, while maintaining a manageable cost.

4. CONCLUSION

Analyzing industrial internship activities can represent the jobs relevant to the industry, serving as a foundation for planning continuous skill development. These internship activities require additional supporting data, which can be sourced from internship report documents that demonstrate completing tasks from unit identification, work steps, and result testing. Through supplementary data obtained from interviews with internship supervisors, it is possible to explore further the requirements or initial qualifications that students must possess before being deployed to the industry, thereby enriching the data considerations for skill development. A systematic approach, from data collection to data analysis, produces a map of relationships between codes that supports research results, which can be referred to as mapping sustainable skills based on industrial internship activities. The automotive after-sales industry primarily focuses on providing maintenance and repair services for automotive products, thus dominated by jobs requiring hard skills equivalent to ISCO skill level 2. However, understanding and applying work knowledge equivalent to ISCO skill level 1 is a foundation for workers in this industry. Jobs equivalent to ISCO skill levels 3 and 4 are available, but not as extensively as technical jobs at ISCO skill level 2. This is because positions at ISCO skill levels 3 and 4 are held by workers with advanced capabilities in both technical and non-technical tasks, acting as key decision-makers and policy influencers within the industry. These skills can be developed through problem-based learning, project-based learning, simulation-based learning, and work-based learning models, as part of continuous skills development programs.

Developing skills in this industrial sector shapes learners through the understanding and implementing of work by considering the type of work according to the ISCO skill level, learning models, learner readiness, and skills as the output. Innovations in learning models are needed to achieve skills based on relevant soft skills according to industry needs. The data obtained through this analytical study form an integrated framework that can be adopted in other sectors to develop relevant vocational education skills without bringing the industry directly into educational institutions, thereby saving costs. Curriculum development, research, and the suitability of learning models need to be conducted to further test the results of the mapping from the industrial internship activity analysis process, so that relevant competencies can be updated each time learners undertake industrial internships

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AUTHOR CONTRIBUTIONS

Rasyid Sidik designed the study, conducted the analysis, collected the data, and wrote the manuscript. Ngatou Rohman, the industrial internship coordinator, managed the internship activities, supported the availability of research data, and reviewed the research results.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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