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Evaluation of the Competency and Skills Needs for Seaplane Maintenance in Pilot Education at the Indonesian Pilot Academy Banyuwangi

Hadi Prayitno[1(*)], Sunardi[2], Ahmad Mubarok[3], Demmy Setyo[4], Setyo Hariadi[5]
[1,3,4,5]Akademi Penerbang Indonesia Banyuwangi, Banyuwangi, Indonesia
[2]Politeknik Penerbangan Palembang, Palembang, Indonesia

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Abstract

This research assesses the competency and skill requirements for Seaplane aircraft maintenance in the pilot education program at the Indonesian Pilot Academy Banyuwangi. Utilizing qualitative methods, including in-depth interviews and direct observation, the study involves students and teachers in the pilot education program. Analysis reveals crucial competencies for students, encompassing a profound understanding of Seaplane aircraft systems, adept problem-solving during operations, and the capacity for quick and precise decision-making. Special skills, such as adaptability to complex working conditions and meticulousness in maintenance procedures, are also deemed essential. The research identifies alignment between the academy's curriculum and Seaplane aircraft maintenance needs, yet highlights specific areas requiring enhancement. The study recommends strengthening the curriculum and teaching methods to better address competency and skill needs. Implementing these recommendations is anticipated to elevate the quality of graduates, ensuring they are well-equipped to meet the challenges of Seaplane aircraft maintenance in the aviation industry.

Keywords: Competency, maintenance, seaplane, skills

(*) Corresponding Author: hadi.stpi@gmail.com

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INTRODUCTION

The aviation industry has a strategic role in global mobility and connectivity, and aircraft maintenance is an important part of maintaining aircraft safety and performance. In the context of aviation, Seaplane aircraft are a relevant choice because of their ability to operate to and from water, which allows access to areas that are difficult to reach by conventional aircraft. However, Seaplane aircraft maintenance demands special skills and knowledge that differ from those of conventional aircraft.

The pilot education program is an important foundation in producing professional personnel in the aviation industry. For the Indonesian Pilot Academy Banyuwangi as one of the pilot education institutions in Indonesia, maintaining the quality and relevance of the educational program curriculum is crucial. Therefore, it is necessary to carry out a comprehensive evaluation of the competency and skill requirements in Seaplane aircraft maintenance taught in pilot education programs.

This evaluation is important because of rapid changes in aviation technology and the evolving needs of the industry. Guaranteeing the safety and quality of Seaplane aircraft is very dependent on the ability of pilots to carry out proper and efficient maintenance. As a pilot education institution that is expected to produce graduates who are ready to face challenges in the field, the Indonesian Pilot Academy Banyuwangi needs to ensure that the curriculum and teaching approaches used are in line with the practical needs that exist in the aviation industry.

The aim of this research is to identify and evaluate the need for special competencies and skills in Seaplane aircraft maintenance that must be mastered by pilot education program students at the Indonesian Pilot Academy Banyuwangi. In addition, the research aims to assess the level of competency and skills needs based on student perceptions, evaluate the suitability of the curriculum, identify the obstacles faced, and formulate recommendations for improving the curriculum and teaching methods to better meet these needs in the aviation industry.

Therefore, this research will provide an important contribution in gaining a better understanding of the competency and skill requirements in Seaplane aircraft maintenance required by student pilots. It is hoped that the results of this evaluation can become the basis for the Indonesian Pilot Academy Banyuwangi to improve and develop pilot education programs, so that graduates of this program are ready to contribute effectively and efficiently in the field, especially in the context of Seaplane aircraft maintenance which is increasingly relevant in the modern aviation era.

Literature Review

Pilot Vocational Education Concept

Pilot vocational education is higher education that is specifically designed to prepare students to have work competencies in accordance with needs in the aviation sector. Several previous literature and research shows that the curriculum in pilot vocational education must be adapted to the competency and skills requirements needed in the aviation industry (Violita, 2020; Widayati et al., 2021). This is necessary so that graduates of pilot educational institutions have competitiveness and are ready to go straight to work as professional pilots after graduating. Research by Amara et al. (2008) found that there is a gap between the competency of aviation diploma program graduates and the pilot competency standards set by Indonesian civil aviation regulations. Therefore, it is important to evaluate and adapt the pilot education curriculum to regulations and industry needs on a regular basis.

Seaplane Pilot Education Concept

Seaplane pilot education requires a different curriculum and practical facilities compared to land plane pilot education programs in general. This is because seaplane flight operations have special characteristics related to flight techniques in water bodies as well as supporting infrastructure such as docks and floating facilities. Several previous studies by Kaur & Hirudayaraj (2021) and Rismi et al. (2020) show that the seaplane pilot education curriculum needs to emphasize a balance of learning aeronautical and nautical theory as well as water take-off and landing flight practices so that graduates are ready to become seaplane

pilots. Apart from that, access to simulators and real practice facilities on water bodies is also important for seaplane pilot graduates mastering water operation competencies.

Seaplane Maintenance - Principles and Importance in Aviation

Maintenance for seaplanes has slightly different principles and technical implementation compared to maintenance for conventional aircraft operating on land. This is partly due to the special construction of the amphibious aircraft fuselage which is capable of flying and landing on both land and water, as well as supporting engines and instruments for amphibious operations (Evangeline & Thavakumar, 2015). Because the bottom surface of a seaplane's fuselage is in direct contact with water during water operations, regular inspection and maintenance of the condition of the aircraft's hull is very crucial. Apart from that, propellers, diesel engines and hydraulic systems supporting water operations also require special attention in the seaplane maintenance program, which is very different from land plane maintenance (Permata & Prajitno, 2018). Considering that seaplane flight operations are often far from land and official hangar and repair facilities, pilots are required to have basic level maintenance knowledge and skills in order to remain able to maintain the airworthiness of their aircraft. Thus, proper aircraft maintenance is crucial to maintaining safe seaplane flights.

Competency Requirements in Seaplane Maintenance

There are a number of specific technical and non-technical competencies required by seaplane pilots and technicians in order to maintain the airworthiness and safety of these amphibious operations. These include competencies related to the principles of aerodynamics of aviation in air and water, nautics and water navigation, to maintenance of ship hulls and main propulsion diesel engines (Siahaan & Supriyadi, 2022). The seaplane pilot education curriculum must be designed so that graduates have mastered these core competencies. Then, in terms of aircraft maintenance, special competence is required regarding amphibious aviation systems and their main components such as aircraft hulls, propellers, diesel engines and hydraulic-based instruments (Harianto & Anshori, 2022). These overall competencies certainly go far beyond standard aircraft maintenance knowledge, so that pilot education providers need to routinely evaluate and adjust curriculum, learning methods, and lecturer development so that they are appropriate and able to meet competency needs in the field of seaplane aviation.

Skills Required in Seaplane Maintenance

Apart from mastering theoretical competencies as mentioned above, seaplane pilots and technicians are also required to master a number of practical skills (psychomotor skills) in order to carry out maintenance and repairs on their aircraft. Some examples of technical skills required include the ability to maintain aircraft hulls, propeller shaft maintenance, diesel engine overhouling, and troubleshooting hydraulic systems and vital instruments for seaplanes (Berman & Pasaribu, 2021). Considering the limited facilities and access to official workshops in the field, pilots must have the technical skills to handle emergency problems on the aircraft to maintain its airworthiness until it lands at the nearest airport. Apart from that, direct

practice and experience in the field in real conditions will also really help pilots and technicians in honing their skills in maintaining and repairing seaplanes (Sari et al., 2018). Therefore, learning methods in pilot educational institutions need to be designed so that students do a lot of maintenance practice on land and seaplanes using simulators and actual aircraft. Thus, pilot education graduates will be better prepared and reliable in applying seaplane maintenance skills after entering the aviation industry.

Related Research on Pilot Education and Seaplane Maintenance

Several related studies have been conducted regarding pilot education and Seaplane aircraft maintenance, including: evaluation of the Seaplane aircraft maintenance training program by Eskandar (2023) which provides insight into effective teaching methods; research by Budiyanto & Suyanto (2020) regarding the evaluation of competency needs for Seaplane pilots which provides competency and skills guidance; a case study by Priyono et al. (2020) on Seaplane aircraft operational and safety practices that provides insight into maintenance challenges; identification of technician training needs by Ekantiningsih & Sukirman (2023) who recommends types of competency enhancement training; as well as research on the challenges and opportunities for pilot training and maintenance of Seaplane aircraft by Knez et al. (2022). Through reviewing these related studies, this study can gain a better understanding of the suitability of the curriculum and teaching methods in pilot education programs with the competency and skills requirements in Seaplane aircraft maintenance.

METHODS

This research uses a qualitative type of research with a case study approach that focuses on the case of the pilot education program at the Indonesian Pilot Academy Banyuwangi. Evaluate the competency and skill needs for Seaplane aircraft maintenance in depth from data collected through interviews, observations and document analysis related to the curriculum and processes. In analyzing the qualitative data obtained from interviews with students, several prominent themes emerged, shedding light on their experiences and perspectives.

RESULTS & DISCUSSION

Evaluation of Competency Needs in Seaplane Maintenance

Competencies required by students

Based on the results of data collection in the field by conducting interviews with a number of pilot education program students at the Indonesian Pilot Academy Banyuwangi, interview data was obtained as shown in the following table:

Table 1. Interview Data

No	Response 1	Response 2	Response 3	Response 4	Response 5	Response 6
M1	I feel it's important to understand the latest	I can develop much needed	I still find the technical aspects of maintenance challenging	The class guides me in understandin g strict	Practical expertise helps me feel more	Learning to work together in teams in maintaining the Seaplane

	technology in Seaplane maintenance	practical skills		safety protocols	confident in the field	
M2	Understanding the latest technologies and developments is truly important in maintenance	Maintenance provides really relevant practical skills	There is some pressure when dealing with problems, but it makes me grow	It's important to master theory and apply it in real situations	The challenges in class reflect situations in the industry, preparing me better	Collaboration and communication in teams are key skills taught
M3	The latest technology is not just about mechanics, but also about keeping up with developments	The practical skills taught in class are very relevant to the aviation industry	Technical aspects can be challenging, but it makes me more perseverant in learning	Understanding regulations and safety is the core of Seaplane maintenance	Understanding aircraft components streamlines maintenance efficiently	Classes teach the ability to adapt to unique work environments
M4	It is important to keep up with Seaplane technological developments	Practical skills help me feel more prepared to face challenges in the industry	There is pressure when dealing with new problems, but that is part of growth	Understanding regulations and safety protocols is much needed in maintenance	Practical expertise helps me feel more confident in facing problems	Learning to adapt to a unique work environment is part of the class
M5	Understanding the Seaplane system is very important in maintenance	The class helps hone the practical skills needed in the industry	Difficulties in technical aspects are challenges that can be overcome by studying harder	It is important to properly understand regulations and safety standards	The class helps me adapt to the unique work environment in the aviation industry	Collaboration in teams is taught as an essential skill in maintenance
M6	Seaplane technology continues to evolve, and we must keep up	The practical skills taught in class help me feel more confident	Technical challenges are part of the learning process and understanding maintenance	Understanding regulations and safety standards is part of good maintenance	Practical expertise helps me adapt to unique job demands	Classes teach how to communicate and collaborate in teams
M7	In-depth understanding of the Seaplane	Maintenance classes provide much	Technical challenges are part of	Understanding regulations and safety	Practical skills help me adapt to unique	Collaboration in teams is taught as an important

	system is very important	needed practical skills	the learning experience	standards is an integral part of maintenance	working conditions	aspect of Seaplane maintenance
M8	Keeping up with Seaplane technological developments is our responsibility	The practical skills I learned help me feel more prepared in the field	Pressure when dealing with new problems is part of the learning process	Understanding regulations and safety is an important part of aircraft maintenance	Practical expertise helps me feel more confident in facing industry challenges	Classes help us learn to communicate and collaborate in teams
M9	In-depth understanding of Seaplane components makes maintenance more efficient	Maintenance classes help develop much needed practical skills	Difficulties in technical aspects are challenges that can be overcome by studying harder	Understanding regulations and safety standards is the foundation of Seaplane maintenance	Understanding aircraft components helps me adapt to unique working conditions	Learning to communicate and collaborate in teams is an important aspect of our program
M10	I realize that challenges in class reflect situations in the aviation industry	In-depth understanding of Seaplane maintenance makes me feel more prepared	A little pressure is part of growth and preparation for facing real situations	Understanding regulations and safety protocols helps ensure safe maintenance	Practical expertise helps me adapt to the unique demands of the job in the industry	Classes teach collaboration and communication skills in teams well

Source: Results of primary data collection by researchers, 2024

Based on student responses in interviews conducted previously, it can be described that students consistently consider an in-depth understanding of the latest technology and developments in Seaplane aircraft as the basis for effective maintenance, assessing practical skills from maintenance classes as relevant in preparing to face challenges in the industry despite technical challenges. as part of the learning process to develop and understand maintenance as a whole, recognizing the importance of understanding safety regulations and standards in the context of maintenance as an integral part of their duties where practical skills help adapt to the industry's unique work environment as well as recognizing the importance of flexibility in dealing with job demands, and views collaboration and communication within teams as essential skills in maintenance where the ability to collaborate is considered an important aspect of the program.

Teachers' perceptions of competency needs

Based on interviews, there are several key elements that reflect the teacher's perception of the need for Seaplane aircraft maintenance competency. Lecturers emphasize a teaching approach that combines theory and practice by providing direct experience as the key to developing students' practical skills. They evaluate competencies holistically with an emphasis on in-depth understanding, practical skills, and the ability to apply knowledge (Mikuskova, 2023).

Teachers also continue to adapt the material to cover the latest developments in Seaplane aircraft design and technology so that students have a strong foundation for

dealing with aircraft with the latest technology. They emphasize the importance of bringing industry experience to the classroom through professional visits or invitations that give students first-hand insight into job demands. Even though there are challenges such as material relevance and motivating to overcome pressure, teachers actively collaborate with industry to ensure the curriculum meets needs and continues to follow developments to provide the latest understanding and skills to students. Educators recommend increasing investment in facilities, program flexibility to changing industry needs, and close collaboration and networking with industry to improve the quality of pilot education programs.

Conclusion of needs evaluation

From the evaluation of the competency requirements required by students and teachers' perceptions, it can be concluded that practical skills in maintaining Seaplane aircraft are the main key. This includes in-depth understanding of aircraft systems, inspection and problem diagnosis skills, understanding of regulations, to the ability to adapt to the industry's unique work environment. Industry experience is also important in helping students understand the real work context and face realistic challenges, which teachers actively introduce through collaboration with the aviation industry (Pentang et al., 2023).

The latest technological developments in Seaplane aircraft encourage curriculum adaptation so that students are given insight into the latest technology and are prepared to face it. Additionally, collaboration, communication, and teamwork skills were also identified as important by students and faculty, underscoring the importance of working in a cooperative team environment. Thus, the evaluation results highlight a holistic approach to teaching that combines theory and practice to prepare students with skills that are relevant and adaptive to changes in the context of Seaplane aircraft maintenance.

Evaluation of Special Skills in Seaplane Maintenance

Need for special skills mastered by students

Direct observations of students were carried out in order to gain an in-depth understanding of the special skill requirements for Seaplane aircraft maintenance, where it was observed that students were skilled at using mechanical tools to assemble and maintain engines and adjust mechanical systems, able to carry out careful visual inspections of aircraft structures and identify signs of damage. who demonstrated good visual skills, as well as fluently handling maintenance of avionics systems and repairing aircraft electronic equipment, apart from that, several students were also involved in aircraft-specific navigation and maneuvering exercises which demonstrated an understanding of aircraft's unique navigation as well as the ability to implement confident maneuvers, they also handled emergency simulations with response fast and good implementation of safety procedures, demonstrated critical situation handling skills, and was involved in group tasks that required good communication and collaboration skills between students, where when facing technical challenges during maintenance, students were also observed using problem solving skills effectively (Rahayu et al., 2023).

Teacher perceptions of specific skills

Teachers emphasize practical skills such as careful technical inspection, understanding special systems, and identifying and fixing problems as the main foundation that students must master, where skills development is integrated in every aspect of learning through real situation simulation projects to ensure the application of skills at various stages, despite challenges. ensuring students' understanding that skills must be applied carefully in the field, not just theoretical which is overcome with an emphasis on direct practice and real experience, besides that it is necessary to adjust the curriculum to cover

the latest skills along with technological developments so that students are able to adapt and integrate new skills, where good industrial experience is through visits or collaboration really helps not only develop skills but also understand the application context, while collaboration and team communication skills are also emphasized as integral aspects taught working together in maintenance teams according to industry demands, with skills evaluation through practical exams, projects and field simulations to provide an accurate depiction of the student's ability to apply specific skills in Seaplane aircraft maintenance (Widiana et al., 2022).

Specific skills evaluation conclusion

Based on the results of the evaluation of special skills in Seaplane maintenance which includes the skills mastered by students and the teacher's perception of special skills, several conclusions can be drawn. Educational programs can further strengthen practical training to ensure students can apply specific skills effectively in the field. The integration of industry experience can be enhanced to provide deeper insight into the application of skills in real work environments. Teachers can continue to adapt the curriculum to technological developments, ensuring students gain a deep understanding of the latest skills. Team collaboration and communication need to be further emphasized, considering the importance of this aspect in Seaplane aircraft maintenance which involves teamwork.

Level of Competency and Skills Needs According to Students

Analysis of student perceptions of competency needs

Based on the results of interviews with previous students, their findings and statements provide an in-depth understanding of their perceptions of the need for competency in Seaplane aircraft maintenance. Students consistently recognize the importance of having in-depth knowledge of Seaplane aircraft systems. They highlighted the need to understand the latest technology and developments in Seaplane aircraft. Practical skills, such as carrying out technical checks, maintaining machines, and troubleshooting technical problems, are considered crucial. Students find that these skills help them feel more confident on the field.

A thorough understanding of safety regulations and standards is recognized as an important cornerstone of Seaplane aircraft maintenance. Students recognize that this contributes to safety and quality of maintenance. The ability to adapt to the unique working environment of Seaplane aircraft is considered an important skill. Students mentioned that experience in various situations helped them become more flexible and ready to face challenges. Students also recognize the importance of communication and collaboration skills in teams. They considered that working together as a team in Seaplane aircraft maintenance strengthened their understanding and work efficiency. In general, students consider the curriculum and teaching methods at the Indonesian Aviation Academy Banyuwangi to be relevant to practical needs in industry. However, some highlighted a desire for more practical exercises and field simulations. Some students admit there are challenges in understanding technical aspects, but they see it as part of the learning process that encourages them to study harder.

Analysis of student perceptions of specific skills

Based on interviews with students, several key findings can be drawn that reflect their perceptions of specific skills in Seaplane aircraft maintenance. Students consider mechanical skills, including the ability to disassemble and assemble aircraft components, as a crucial aspect in Seaplane aircraft maintenance. Several students demonstrated their skills in using mechanical tools efficiently. Visual inspection is considered an important skill. Students demonstrate the ability to perform a thorough visual inspection of aircraft

structures, accurately identifying signs of damage, wear, or leaks.

Skills related to avionics and electronic systems are an important focus. Students who successfully complete avionics-related maintenance assignments demonstrate sufficient technical skills, including identification and repair of aircraft electronics problems. Students involved in navigation exercises demonstrate understanding of navigation aspects unique to Seaplane aircraft. They can execute specific maneuvers with confidence, demonstrating the necessary operational skills. Emergency handling skills are considered important by students. In simulated emergency situations, they demonstrated quick and appropriate responses and implemented safety procedures well. Students also recognize the importance of communication and collaboration skills in teams. They engage in group assignments, demonstrate good communication skills, and collaborate in the exchange of ideas and coordination of tasks.

Suitability of Curriculum to Needs

Analysis of curriculum suitability with competency needs

Analysis of the suitability of the curriculum with competency requirements in Seaplane aircraft maintenance was carried out by considering findings from student interviews and instructor perceptions. The following is an analysis that can be taken. Firstly, the importance of practical skills in Seaplane maintenance is highlighted. Students and faculty agree that practical skills, such as mechanical ability and visual inspection, are important aspects of Seaplane aircraft maintenance. In this case, the suitability of the curriculum looks good if practical skills have become the main focus. However, further development of teaching methods that support the practical application of skills needs to be considered. Furthermore, the integration of multidisciplinary skills is also a concern. Students understand that Seaplane aircraft maintenance requires skills in various fields, such as mechanics, electronics and operations. Therefore, curriculum suitability can be strengthened by ensuring that these aspects are well integrated in each relevant course. Apart from that, fast response in emergency situations is also considered important by students. Curriculum evaluation needs to ensure that emergency situations and handling skills are an integral part of the curriculum.

Analyze the suitability of the curriculum to skills needs

Curriculum suitability analysis is carried out to ensure the curriculum provides the right foundation for students to face industry demands. It was found that the curriculum provided adequate focus on the essential practical skills needed in the field and well integrated maintenance-related mechanical, electronic, and navigation courses. However, regular evaluation and updates are needed to follow developments in Seaplane aircraft technology so that students remain relevant to industrial advances. In addition, an action-based evaluation approach through practical exams, maintenance projects, and field simulations also supports by providing an accurate picture of students' ability to apply skills in real situations. On the other hand, increased industry involvement and the use of field simulations will further strengthen the suitability of the curriculum to ensure students are exposed to situations that represent the world of work.

Discussion

The research results show that Seaplane aircraft maintenance requires in-depth knowledge of aircraft systems and an understanding of technological developments (Student 1, 2, 5). This is in line with the Human Performance Factors theory which emphasizes understanding technology as a key element in maintenance. Mechanical skills, visual inspection, and problem solving emerged as important competencies. Human

Factors Engineering theory supports that these skills are the main factor in maintaining aircraft safety and performance (Salas et al., 2010).

Students emphasized the importance of an in-depth understanding of Seaplane aircraft systems (Student 3, 4, 6). Expectancy-Value Theory can be used to understand that if students see value and relevance in this understanding, they will be more motivated to acquire these competencies (Eccles & Wigfield, 2002). Challenges in technical aspects are considered as part of growth (Student 2, 4, 7). This reflects an approach involving personal development theory, where overcoming technical challenges is considered a step toward maturity and success.

Findings show that there is a mismatch between the curriculum and competency requirements (Student 5, 9; Teacher a). The ADDIE (Analysis, Design, Development, Implementation, Evaluation) model can help in understanding that evaluation and changes need to be made in the curriculum development stage. The integration of practical skills in every aspect of learning was recognized as important (Teacher b). This supports a constructivist approach to learning design, where practical experience is the main foundation in building knowledge.

The observation results show that students can apply mechanical skills and visual inspection well (Observations a, b). Situated Learning Theory supports that the best skill learning occurs when there is direct interaction with a practical context (Hariri et al., 2020). Teachers' perceptions about the importance of practical skills as the main foundation (Teacher a) are in line with the theory that learning that occurs in real contexts has a greater impact on skills development.

Thus, through the integration of research findings with supporting theories, it can be concluded that an emphasis on in-depth understanding, practical skills, and suitability of the curriculum to industry needs are key elements in preparing pilot education program students in Seaplane aircraft maintenance. By understanding this conceptual framework, educational institutions can optimize learning to increase graduates' readiness to face the demands of the aviation industry.

CONCLUSION

This study provides in-depth insight into the competency and skill requirements for Seaplane aircraft maintenance, where students are expected to have an understanding of aircraft systems including the latest developments as well as mastering technical skills, understanding regulations and safety standards, and the ability to adapt to unique work environments as key competencies, and that students have develop mechanical skills, visual inspection, electronics, navigation, emergency handling, team communication, and problem solving, the integration of which in the Seaplane aircraft maintenance curriculum will help understand the application context in the field, where students realize the importance of in-depth understanding and skills in pursuing a career as a Seaplane aircraft maintainer so that considered a growth and skills development opportunity, with an appropriate curriculum providing a focus on essential skills, integration of relevant courses, action-based evaluation, industry engagement, and field simulations supporting its suitability.

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