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Development of Applied Mechanical Engineering Undergraduate Curriculum Based on Industry Needs

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ABSTRACT

The curriculum currently used in many universities is still not fully aligned with industry needs, causing a gap between graduate competencies and workplace expectations. Many graduates experience difficulties in finding employment because their skills do not match industry demands. To overcome this problem, the development of an industry-based curriculum is a strategic solution involving various stakeholders such as industry, academics, and alumni. This study used the Research and Development (R&D) method with the Borg & Gall development model, which includes 10 stages. The results show that the new curriculum for the Mechanical Engineering Applied Bachelor Program emphasizes a greater proportion of practice (60%) compared to theory (40%). This new curriculum is designed to be more relevant to industry needs, integrating the latest technology. Trials of the new curriculum show a 12% increase in students' practical competencies, while the industry partner satisfaction rate reaches 88%, indicating the effectiveness of the new curriculum product.

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INTRODUCTION

The development of an applied mechanical engineering undergraduate curriculum based on industry needs is a strategic step to address the challenges faced by higher education in Indonesia (Arief Syamsuddin, 2024). With the rapid development of technology and ever-changing industry needs, universities are required to produce graduates who not only have theoretical knowledge but also relevant practical skills (Tanto Ramdhan, 2011); (Ahda Sabila et al., 2024). Therefore, it is important to create a curriculum that is responsive to the dynamics of the job market and industry needs. The current curriculum is often not in line with the real needs in the field. Many graduates find it difficult to get a job because their skills do not match those expected by the industry (Pramesti et al., 2024). This shows the need for periodic evaluation and revision of the curriculum to remain relevant and in line with the times. The development of an industry-based curriculum will involve various stakeholders, including industry, academics, and alumni, to ensure that the curriculum meets the demands of the world of work (Henny Prasetyani, 2019).

One of the government policies that supports this curriculum development is Merdeka Belajar-Kampus Merdeka (MBKM). This policy provides flexibility for students to gain learning experiences outside the campus, including internships in industry (Nirmayanthi et al., 2024); (Adi Setiawan et al., 2023). Thus, students can develop practical skills and professional networks that are useful after graduation. The implementation of MBKM is expected to increase the employability of graduates and respond to the challenges of globalization and competition in the job market. The Indonesian National Qualifications Framework (KKNI) is also an important reference in the development of the applied mechanical engineering undergraduate curriculum. KKNI sets learning achievement standards that must be met by each graduate according to their qualification level. By referring to the KKNI, universities can design curricula that not only meet national standards but are also relevant to industry needs. This is important to ensure that graduates have recognized competencies and can compete in the job market (Susilawati et al., 2022); (Ardi Cahya Direja, 2017).

In the curriculum development process, an in-depth analysis of industry needs is necessary (Sobari et al., 2023). This can be done through surveys of graduate users, interviews with industry players, and case studies of similar education programs in other countries. With accurate data on the skills and knowledge needs of the industry, universities can formulate appropriate learning objectives and develop relevant teaching materials (Setiawaty & Fahmi, 2022). The importance of collaboration between universities and industry in curriculum development cannot be underestimated. Through this collaboration, universities can access the latest information on industry trends, new technologies, and best practices in vocational education. In addition, industry also has the opportunity to contribute to the education process by providing input on the skills needed by the workforce (Sulistyanto et al., 2021).

Curriculum development must consider the aspects of evaluation and feedback from various parties. After the implementation of the new curriculum, an evaluation needs to be carried out to assess its effectiveness in improving student competence. Feedback from students, lecturers, and graduate users is very important for making continuous improvements to the curriculum. Thus, the curriculum will always be relevant and able to respond to existing challenges. Based on this, through this research, the Applied Mechanical Engineering Study Program will conduct research related to industry-based curriculum development to improve the quality of learning in the study program, so that graduates of the Applied Mechanical Engineering Study Program can experience increased absorption in the world of work.

METHOD

To produce a curriculum that meets industry needs, there are several steps that must be taken. This study uses Research and Development (R&D) research. Development research is a research method used to produce a specific product and test its effectiveness. The model used in this research is the Borg & Gall development model. The steps in R&D research are cyclical and include reviewing research findings, developing products based on these findings, testing them in the field in settings where the products will be applied, and revising them based on the results of field testing (Borg & Gall, 1989). The product developed in this study is the Applied Bachelor of Mechanical Engineering Curriculum. The curriculum development was designed with the needs of the partner, PT. Hari Mukti Teknik and PT. MAK Yogyakarta, in mind. In accordance with Borg and Gall (1989), there are 10 stages of research that serve as a reference in this study, including the following:

1. Define (Research and information gathering).

   This activity includes needs assessment, literature review, pre-survey, and reviewing the results of recent research related to the model to be developed. In this study, materials used in the model components and their tools will be produced. In addition, researchers begin to design a curriculum to support the entire learning process so that the objectives of the educational process are achieved.
2. Design.

   This activity includes formulating the curriculum, determining user targets, and establishing curriculum components. This formulation is carried out through theory development and identification of models and their tools in accordance with similar studies. The target users are students majoring in Mechanical Engineering.
3. Develop product.

   At this stage, activities to compile the structure and tools of the curriculum are carried out. In this section, researchers have created designs along with tools and methods for using the curriculum.
4. Preliminary field testing;

   At this stage, the curriculum is validated using FGD through 3-5 curriculum experts and experts from industry.
5. Main product revision.

   Revise the product based on the validation results from the previous stage.
6. Dissemination and implementation.

   This is the final stage, where the product is ready to be communicated to all relevant parties and subsequently implemented.

The research and development steps carried out can be seen in Figure 1.

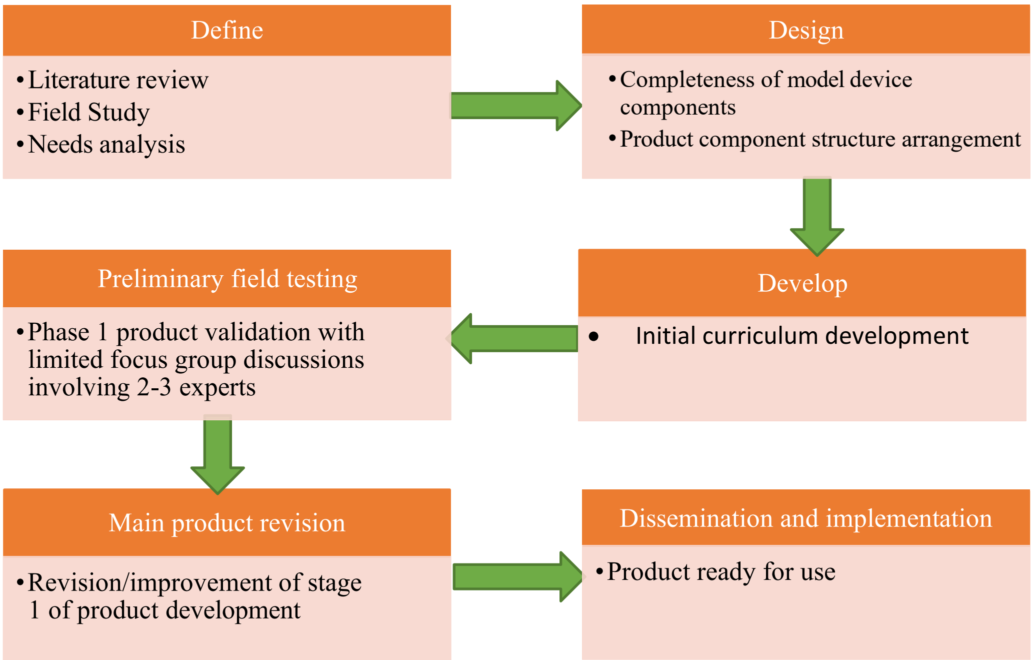

Figure 1. Steps in the Implementation of Development Research.

RESULTS AND DISCUSSION

This research produced a new curriculum for the Applied Mechanical Engineering Undergraduate Program based on industry needs using the Borg & Gall R&D method. The research process began with data collection through literature studies, surveys, and interviews with industry partners, particularly PT Hari Mukti Teknik and PT MAK Yogyakarta, with the results of the data collection shown in Table 1. The results of the analysis showed a significant gap between the old curriculum and the real needs of industry, especially in terms of mastery of the latest technology, practical skills, and graduate work readiness. The old curriculum was still dominated by theory (60%) with limited practice (40%) and short internships of ±2 months. Through a series of development stages, expert validation, field trials, and operational revisions, the new curriculum was designed with a greater proportion of practice (60%), a minimum of 6 months of industrial internships, and the integration of eight new courses. Among them are Industrial Automation, Digital Twin Technology, and Sustainability in Manufacturing as a response to the demands of the Industrial Revolution 4.0.

Table 1. Results of data collection from literature reviews, surveys, and interviews.

Analysis of the old curriculum	• The proportion of industrial practice is less than 30% of credits. • No specific courses on Industry 4.0 and Sustainability in Manufacturing.
Survey results	• 78% of companies emphasize soft skills (technical communication, teamwork). • 64% of companies request improved mastery of the latest manufacturing technologies.
Industry data	• PT Hari Mukti Teknik (main partner) requires graduates who are proficient in 2D CAD, 3D CAD, CAD-CAM, surface treatment, body painting, maintenance, quality control, and after-sales service. • The 4th Industrial Revolution demands competencies in IoT, automation, digitalization, big data, and additive manufacturing.

At the Design stage, important points that need to be adjusted in the curriculum based on the data in Table 1 are identified. Identification includes the integration and addition of courses and competencies described in the graduate learning outcomes (GLO). GLO is the goal of implementing the curriculum change so that all items in the GLO can be achieved. Important points from the identification can be seen in Table 2.

Table 2. Key points of the new curriculum design.

Key points of the new curriculum design based on analysis of the old curriculum, survey results, and industry data	• New curriculum objectives: 60% practical, 40% theoretical. Minimum 6-month industrial internship. New courses added: Industrial Automation, Digital Twin Technology, Sustainability in Manufacturing, Industry 4.0 Applications. • The new curriculum structure is based on KKNI Level 6 and GMP for Design and Manufacturing of Machinery. • Addition of 8 new courses, including a capstone project based on real-world industry problems. • Standardized industrial internship guidelines, covering competencies in R&D, production, maintenance, and quality control.

The curriculum development carried out in collaboration with industry partners is formulated in the graduate learning outcomes as shown in Table 3. Furthermore, curriculum changes are made in several categories that reflect the new industry-based curriculum as shown in Table 4.

Table 3. Graduate learning outcomes in the new curriculum

GLO	GLO Statement
GLO 1	Able to master *basic science* knowledge in the field of applied mechanical engineering in the competencies of design, welding, and machining based on logical, critical, systematic, and innovative thinking.
GLO 2	Able to apply skills independently, with quality, and measurably in the field of applied mechanical engineering in the competencies of design, welding, and machining.
GLO 3	Able to improve performance and work quality in the field of applied mechanical engineering with discipline in accordance with quality assurance principles.
GLO 4	Able to perform work based on standards, standard procedures, design specifications, and occupational safety and health (OSH) in the field of applied mechanical engineering through the internalization of academic and professional ethics.
GLO 5	Able to analyze cases to solve engineering problems in the field of applied mechanical engineering by prioritizing religious spirit.
GLO 6	Able to use modern and latest technology responsibly and independently to perform work.
GLO 7	Able to utilize resources, design tools, and engineering analysis of manufacturing processes based on information technology, computing, and automation.
GLO 8	Able to supervise work and be responsible for the achievement of group work results.
GLO 9	Able to collaborate in addressing current issues in economics, social and ecology, and conduct self-evaluation of group work results.

Table 4. Curriculum Development Results

Category	**Current Curriculum**	**New Curriculum (Industry-Based)**	**Main Changes**
Theory vs. Practice Ratio	Theory 60%, Practice 40%	Theory 40%, Practice 60%	Increased proportion of practice in line with industry needs to accelerate *the learning period* of graduates.
Internship/Industrial Practice	Internship ± 2 months	Minimum 6-month industrial internship	Referring to the MBKM policy, providing real work experience.
Basic Engineering Courses	Engineering Mathematics, Engineering Physics, Basic CAD	Engineering Mathematics, Engineering Physics, 2D CAD, 3D CAD, CAD-CAM	Addition of complete CAD stages (2D–3D–CAM).
Industry 4.0 Courses	None	Industry 4.0 Applications, Digital Twin Technology	Incorporating the latest technologies in line with the pillars of the Industry 4.0 revolution.
Sustainability Course	None	Sustainability in Manufacturing	Addressing sustainable industry and energy efficiency issues.
Technology/Project	Simple internal campus project	Capstone Project based on real industry problems	Direct collaboration with partners such as PT Hari Mukti Teknik.

Category	Current Curriculum	New Curriculum (Industry-Based)	Main Changes
Technical Competency Areas	Machine Elements, Manufacturing, Fluid Mechanics	Machine Elements (with *hands-on* real components), *Surface Treatment*, *Body Painting*, *Maintenance*, *Quality Control*	Incorporating direct practice in line with industry job profiles.
Industry Statistics	General Statistics	Industrial Statistics (*Seven Tools* and *New Seven Tools*)	Aligned with quality control requirements in the manufacturing industry.
Professional Certification	None	Embedded Certification: *AutoCAD Certified User*, *CNC Operator*, *Welding Inspector*	Ensuring graduates have industry-recognized certificates.
Industry Visits/Exhibitions	Unstructured	Integrated into courses and industry partnerships	Visits, manufacturing exhibitions, and training in industry are mandatory.
Strengthening Soft Skills	Technical Communication (limited)	Leadership & Teamwork, Human Relations, Professional Ethics	Strengthened based on industry input regarding the need for *a personalized approach*.

At the curriculum validation stage, workshops were held to gather input from industry partners such as PT Hari Mukti Teknik and PT MAK Yogyakarta, which also strengthened the relevance of the curriculum. The industry emphasized the importance of mastering 2D–3D–CAM CAD, machine elements through hands-on practice, and mastering quality control based on the Seven Tools and New Seven Tools. The curriculum revision that accommodates these needs has proven to strengthen the reciprocal relationship between universities and the business world, as also stated by Sulistyanto et al. (2021) that the synergy between vocational education and industry is the key to successfully producing competent workers in the era of the industrial revolution 4.0.

The new curriculum also needs to integrate professional certifications (*AutoCAD Certified User, CNC Operator, Welding Inspector*) to enhance graduate competitiveness. Field trials showed a 12% increase in students' practical competencies and 88% satisfaction among industry partners. The final curriculum has been revised and is ready to be implemented in the 2026 academic year, with the hope of increasing the relevance of graduates to industry needs and strengthening partnerships between universities and the business/industrial world.

The revision of the Applied Mechanical Engineering Bachelor's Degree curriculum development product based on industry needs was conducted based on input and revisions from two related industries. The new curriculum adds courses on Industrial Automation, Digital Twin

Technology, and Sustainability in Manufacturing. This is relevant to the nine pillars of Industry 4.0 technology ( ) which include autonomous robots, simulation, IoT, cybersecurity, cloud computing, additive manufacturing, and augmented reality (Brunkhorst, 2023 in the SV UNY Curriculum Workshop). The integration of these technologies enables students to understand the latest developments and adapt to global best practices. In addition, the integration of professional certifications such as AutoCAD Certified User, CNC Operator, and Welding Inspector into the curriculum is an innovative strategy that strengthens the competitiveness of graduates. As stated by Sobari et al. (2023), industry involvement in curriculum development is not limited to input on material, but also includes quality assurance of graduates through industry-recognized competency certification. A pilot curriculum trial showed an average 12% increase in student practical competencies compared to the old curriculum, as well as an 88% satisfaction rate among industry partners. This proves the effectiveness of integrating certification-based learning in improving graduate quality.

The old curriculum, which still emphasized theory by 60% and practice by only 40%, was not relevant enough to equip graduates to face the dynamics of the industry. This condition is in line with the findings of Pramesti et al. (2024) that the skills gap between college graduates and the needs of the world of work is still a major problem that affects the level of labor absorption. Therefore, revising the curriculum to emphasize a greater proportion of practice is relevant to the demands of the Industrial Revolution 4.0. The implementation of a minimum 6-month industrial internship in the new curriculum supports the Merdeka Belajar-Kampus Merdeka (MBKM) policy as stated by Nirmayanthi et al. (2024). This policy provides opportunities for students to gain real work experience while strengthening their professional networks. The results of this study are also consistent with Arief Syamsuddin's (2024) study, which emphasizes the importance of industry-oriented learning models in mechanical engineering education so that graduates not only have conceptual abilities but also practical skills.

Thus, this research not only produced a new curriculum but also made a real contribution to improving the quality of vocational education. Industry-based curricula have proven to be more responsive to technological changes, reducing the competency gap among graduates and increasing employment opportunities. The practical implication of this research is that vocational colleges need to make industry partnerships a main pillar in curriculum development. In addition, curriculum updates must be carried out continuously by considering graduate user evaluations, global technology trends, and national education policies. Overall, the synchronization between the research results and the literature and policies shows that the Borg & Gall development model is effective in designing vocational curricula. The systematic research stages, from needs identification to final implementation, resulted in a more relevant, adaptive, and applicable curriculum. Through the implementation of this new curriculum, it is hoped that UNY Mechanical Engineering Applied Science graduates will be highly competitive in the national and international job markets and able to respond to the challenges of the modern manufacturing industry.

CONCLUSION

1. Based Curriculum Update: This research resulted in a new curriculum for the Applied Mechanical Engineering Bachelor's Program that emphasizes a greater proportion of practice (60%) compared to theory (40%). This new curriculum is designed to be more relevant to industry needs, integrating the latest technologies such as Industrial Automation, Digital Twin, and Sustainability in Manufacturing. Additionally, longer industrial internships (minimum 6 months) aim to enhance graduates' work readiness, in line with the demands of the Fourth Industrial Revolution.
2. Improved Competence and Industry Partner Satisfaction: Trials of the new curriculum showed a 12% increase in students' practical competence, while industry partner satisfaction reached 88%. This indicates that the integration of an industry-based curriculum involving professional certifications (such as AutoCAD Certified User, CNC Operator, and Welding Inspector) is effective in preparing graduates with the skills required by industry, while also strengthening partnerships between universities and the business world.

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REFERENCES

Adi Setiawan, Amin Suryani, Destriana Kurniawati. (2023). Independent Learning Campus Policy: Encouraging Higher Education Reform in Indonesia. Humantech: Indonesian Multidisciplinary Scientific Journal Vol 2no 5 March 2023.

Ahda Sabila, Putri Mayang Sari, Waskito, Henny Yustisia. (2024). Literature Review: The Role of Industry in Developing Vocational Education Curricula. Tambusai Education Journal Volume 8 Number 2 Year 2024.

Andi Nirmayanthi, Yuspiani, Wahyuddin Naro, Nurhidayah Br. (2024). Analysis of the Merdeka Belajar Kampus Merdeka Education Policy. Journal of Education and Local Wisdom Vol. 4 No. 4 August 2024, pp. 290-299.

Arief Syamsuddin. (2024). Development of an Industry-Oriented Learning Model in Mechanical Engineering Education. Journal of Education and Teaching Review, Volume 7 Number 1, 2024.

Basukiwibawa. (2017). Management of Vocational and Technical Education. Jakarta: BumiAksara.

Borg, W. R., & Gall, M. D. (1989). Educational research: An introduction. 5th ed. New York, NY: Longman.

Direja, Ardi Cahya (2017) Study of the Implementation of the KKNI-Based Curriculum in the Communication Science Undergraduate Program at the Indonesian University of Informatics and Business. Master's thesis, Indonesia University of Education.

Henny Prasetyani. (2019). The Relevance of Multimedia Vocational School Graduates' Competencies to the Needs of the Industrial World. Journal of Systems, Information Technology, and Electronics Engineering Vol 1, No. 1.

Kansha Dianita Pramesti, Nur Indah Meisya, Rizki Amrillah. (2024). The Relevance of Higher Education Graduates to the World of Work. Journal of Islamic Education and Religious Social Studies Vol. 3 No. 4 July (2024).

Kuntang Winangun. (2017) Vocational Education as the Foundation of the Nation in Facing Globalization. Journal of Vocational Park Vol.5, No. 1.

Paristiyanti Nurwardani. (2016) Guidelines for Developing Vocational Learning Technology. Jakarta: Ministry of Research, Technology, and Higher Education.

Mochamad Sobari, Dinn Wahyudi, Laksmi Dewi. (2023). Industry Involvement in Curriculum Development at the Vocational High School Level. Journal of Education and Development Vol. 11, No. 3.

Putusudira. (2012). Philosophy and Theory of Vocational and Technical Education. Yogyakarta, UNY Press.

Sulistyanto Sulistyanto, Farid Mutohhari, Andi Kurniawan, Dianna Ratnawati. (2021). Competency requirements in the era of the 4.0 industrial revolution: a review of vocational education perspectives. Taman Vokasi Journal, 9 (1), 2021, 25-35.

Susilawati, Jamalludin Rahmat, Agus Riyan Oktori. (2022). Implementation of the KKNI-Based Curriculum in Efforts to Strengthen the Quality of Graduates in the PGMI IAIN Curup Study Program. Journal of Basic Education Vol. 6, No. 1, 2022

Tanto Ramdhan. (2017). Mechanical Engineering Vocational Education in the Global Era at SMK Negeri 1 Adiwerna. Jurnal PP Volume 1, No. 2, December 2017.

Tetty Setiawaty, Ichsan Fahmi. (2021). Reducing the Skill Gap of Vocational School Graduates: How to Build a Network of Cooperation Between Vocational Schools and Industry in Sharing Knowledge, Skills, and Information. Spektro Journal Vol. 5 No. 2.