

Application of the OcARI Generative Artificial Intelligence Based on Outcome Based Education in Energy Conversion Machinery Course

- Mechanical Engineering, STT Pekanbaru, Indonesia -

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ABSTRACT

This study explores the integration of Artificial Intelligence (AI) into the Outcome-Based Education (OBE) framework for an undergraduate Energy Conversion Machinery course [MPP13762]. The Generative AI (Gen-AI) plays a pivotal role in addressing challenges within the Indonesian education system by enabling students to learn anytime, anywhere, and on any devices. This approach enhances the effectiveness, accuracy, and transparency of the learning process. Research findings indicate that the AI-enhanced OBE model significantly outperforms traditional approaches, particularly in improving student performance and increasing the proportion of students who retake questions to achieve their desired scores.

KEY WORDS: *Generative Artificial Intelligence; Energy Conversion Machinery; Outcome Based Education; Mechanical Engineering; STT Pekanbaru*

1.0 INTRODUCTION

Education is a pillar of human progress, from ancient times to the

modern era, where education has determined how society functions and how humans develop. With the emergence of AI-driven approaches, traditional teaching remains important; however, while AI technology offers stability, familiarity, and organizational structure, it also possesses inherent limitations that must be addressed in a rapidly changing world.

Traditional teaching methods such as lectures and rote memorization tend to be teacher-centered [*Kasiga School*]. This limits active student participation and often fails to account for diverse learning styles, resulting in a passive, uncritical, rigid, and tedious learning experience. Here are some of the main drawbacks. Instruction is teacher-dominated, meaning students mostly listen rather than actively participate. A focus on rote memorization and repetition hinders the development of creativity and problem-solving skills. It fails to accommodate individual differences in learning pace and style, making it difficult for students who fall behind to catch up. Monotonous delivery of material can diminish students' interest and motivation to learn.

Artificial Intelligence (AI) in learning is revolutionizing education by creating more personalized, efficient, and inclusive learning experiences. AI acts as a virtual assistant that helps students grasp material quickly while simultaneously easing the administrative burden on educators. Here are some key benefits of using AI in learning: personalized and adaptive learning, virtual tutors, improved teacher time efficiency, and enhanced accessibility [*Binus, Indira. 2024*].

This paper discusses the implementation and advantages of The OcARI Gen AI-based OBE in Energy Conversion Machinery

course at STT Pekanbaru, Indonesia.

2.0 RESEARCH METHODOLOGY

2.1 The OcARI Gen-AI Based OBE

The Generative AI (The Gen-AI) is an artificial intelligence that creates new content by recognizing patterns in large training data sets and generating original material. Instead of just analyzing existing information, it functions as a creative partner that generates entirely new, contextually relevant material based on user prompts. The Gen-AI models rely on deep learning algorithms and are trained on billions of parameters to understand the relationship between words, pixels, or notes.

The OcARI Gen-AI project was initiated by Jaswar Koto in early 2013 at Aeronautical and Naval Architecture and Offshore Engineering, UTM, Malaysia. The OcARI Generative AI is a Generative-AI that is used for specific purposes such as aerospace and ocean like the OcARI GEN-AI "Bahari". The OcARI Gen-AI project is a collaboration project with colleagues from Tokyo University and Hiroshima University, Japan and University of Riau, Indonesia. In 2019, a computer version of The Gen-AI was released to identify fish which was named Bahari, The Bahari was assembled at Mechanical Engineering, UNRI.

The OcARI Generative Artificial Intelligence (Gen-AI) applies AI to naval architecture. It transforms the Ship Structure course by assessing engineering knowledge, scientific reasoning, and logic abilities in alignment with Outcome-Based Education (OBE) models. The OcARI Gen-AI and Outcome-Based Education (OBE) are a perfect match in which The Gen-AI automates the alignment of curricula, dynamically generates assessment rubrics, and tailors personalized learning pathways. Together, they ensure teaching directly meets specific, measurable learning outcomes while reducing faculty workload.

2.2 Implementation of OBE in Mechanical Engineering, STT Pekanbaru

The Mechanical Engineering Study Program at STT Pekanbaru began implementing an Outcome-Based Education (OBE) curriculum in the Even Semester of the 2024/2025 Academic Year, holding a current accreditation status of "Very Good" (*Baik Sekali*). This implementation was introduced and aligned through a series of "OBE Constructive Alignment" workshops organized by the Faculty of Engineering in February 2025 and is subject to continuous evaluation via Internal Quality Audits. The adoption of the OBE curriculum focuses on aligning graduate competencies with the needs of the maritime industry through three key stages: developing an industry-aligned curriculum, implementing project-based assessment, and conducting continuous evaluation. Graduate profiles (Program Educational Objectives) are directly tailored to input and feedback from maritime industry partners; learning methods have shifted from classroom theory to real-world projects (such as ship construction, design, or analysis), with assessments (Course Learning Outcomes) based on students' practical

capabilities; and the process utilizes the PDCA (Plan, Do, Check, Act) method is supported by STTP's LPMPP to ensure alignment between learning outcomes and professional competencies.

2.2.1 Curriculum Design and Mapping Based on OBE

Outcome-Based Education (OBE) Curriculum Design and Mapping is an educational framework where every component of instruction, learning, and assessment is centered on what students should know and be able to do (outcomes) upon completing a program. The process relies on designing backwards and aligning content perfectly. The OBE hierarchy defines outcomes from the broadest to the most specific, ensuring every assignment contributes to a graduate's overall employability. Curriculum mapping visually tracks how well each course supports the overall PLOs. This ensures there are no gaps or unnecessary overlaps in the learning journey as follows: Develop a Matrix, Determine Mapping Strength, Align Assessments and Taxonomy Integration. The following is an example of a program specification, course outline, and course learning outcome matrix of Energy Conversion Machinery, STT Pekanbaru, Indonesia.

2.2.2 Tailored Assessments

Tailored assessments in Outcome-Based Education (OBE) are designed to measure whether students have mastered specific, pre-determined competencies rather than how well they memorize facts. These evaluations are highly aligned, student-centered, and personalized to verify that learners can apply their knowledge in real-world scenarios.

Tailored assessments ensure that the learning process, teaching methods, and evaluations are all aligned to hit specific target goals. Defined Outcomes: Evaluations are tied to specific Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs). Criterion-Referenced: Students are evaluated against clear performance criteria, not graded on a curve or compared against their peers. Constructive Alignment: The way you test students must directly reflect the skills they need to demonstrate.

Instead of relying solely on traditional pen-and-paper exams, tailored OBE assessments utilize a variety of practical and applied methods: Project-Based Assessments, Rubrics, Portfolios and Case Studies. Require students to design or create something that solves a complex, real-world problem, Provide structured, transparent criteria that show students exactly what skills or knowledge are being measured (e.g., assessing accuracy, logic, and presentation), Collections of student work collected over time to demonstrate continuous skill development and mastery and Measure analytical and problem-solving abilities by giving students real-life scenarios to troubleshoot.

2.2.3 Continuous Quality Improvement

Continuous Quality Improvement (CQI) within Outcome-Based Education (OBE) is a systematic, data-driven cycle. It ensures educational programs continuously evaluate and refine teaching methods, assessments, and curriculum based on measured student

outcomes to meet industry and international standards. CQI is crucial for accreditation alignment, continued relevance, and student success. CQI is a core requirement for international academic quality frameworks like the Washington Accord, ABET, or AUN-QA. As industry needs change, CQI ensures educational content never becomes obsolete. It provides a personalized, proactive approach by identifying learning gaps and ensuring every student can achieve the target competencies.

CQI transforms OBE from a static administrative task into a dynamic, evolving system. By constantly measuring what students learn and adjusting the curriculum, institutions produce graduates who are highly competent and ready for the workforce. The CQI process in an OBE framework generally operates in a structured, cyclical approach:

1. Plan (Define Outcomes) Establish Benchmarks: Define the Program Learning Outcomes (PLOs) and Course Learning Outcomes (CLOs) aligned with professional, societal, and accreditation standards. Design Curriculum: Structure the syllabus to ensure every topic actively contributes to these expected outcomes.
2. Do (Implement and Assess) Execute Teaching: Deliver lessons using outcome-based learning and teaching methods (e.g., project-based learning, case studies). Measure Progress: Evaluate student performance through targeted assessments (rubrics, portfolios, presentations) specifically designed to test the CLOs.
3. Check (Evaluate Data) Analyze Attainment: Collect assessment data to see if students met the Key Performance Indicators (KPIs) for each outcome. Gather Feedback: Compile evaluations and surveys from students, alumni, and employers to gauge real-world effectiveness.
4. Act (Close the Loop) Identify Gaps: Pinpoint exactly where student outcomes fell short of expectations (e.g., if only 75% of students met the threshold for a specific practical skill). Implement Changes: Revise teaching materials, adjust assessment weights, or modify curriculum content to address these shortcomings for the next academic year.

3.0 RESULTS AND ANALYSIS

3.1 The OcARI Gen-AI OBE Based

The OcARI Gen-AI for education is an Artificial Intelligence- Outcomes Based Education [AI-OBE] that can automatically analyze competencies and reasoning abilities through question and answer analysis in assignments, projects, experiments, and exams, thereby assisting lecturers in the creation of Course Review Reports [CRR] for students. The OcARI Gen-AI based on OBE has the following features: Registration, Lecturers & Assessment, Class Minutes & Self Study, Projects Industrial Attachment, Experiments, Final Project, Grade & Transcripts and Continuous Quality Improvement [CQI].

The screenshot displays the OcARI Gen-AI website interface. At the top, there are logos for 'OcARI Gen-AI' and 'OcARI Gen-AI' with sub-labels 'OcARI Gen-AI' and 'OcARI Gen-AI'. Below these are four icons representing different aspects of the program. The main content area features the title 'The OcARI Gen-AI [Outcome Based Education]' and a subtitle 'The OcARI Generative Artificial-Intelligence OBE for Education'. The text describes the program's origin at Universiti Teknikal Malaysia Melaka (UTeM) and its focus on using AI for OBE. A navigation menu on the left includes sections like 'REGISTRATION', 'LECTURES & ASSESSMENT', 'CLASS MINUTES & SELF STUDY', 'PROJECTS', 'EXPERIMENTS', 'FINAL PROJECT', 'GRADE & TRANSCRIPTS', 'CONTINUOUS QUALITY IMPROVEMENT (CQI)', 'SERVER MANAGEMENT', 'LANGUAGES CENTER', and 'THE GEN-AI LC'. The bottom of the page features a footer with the text 'Published by International Society of Ocean, Mechanical and Aerospace Scientists and Engineers, www.isomase.org., ISSN: 2502-3888'.

https://ai.ocari.net/Kampus/STTP/STTP

Figure 2: Features of The OcARI Gen-AI Based on OBE

3.2 The OcARI Gen-AI Applied to Energy Conversion Machinery Course in Mechanical Engineering, STT Pekanbaru

As a case study, the Energy Conversion Machinery course [MPP13762] based on Outcomes Based Education [OBE] was used. By automating and evaluating complex computations, OcARI helps students and researchers quickly grasp hull design and structural integrity.

Real-time Performance Prediction

OcARI utilizes machine learning to rapidly calculate ship hull resistance and total deformation, eliminating the wait times associated with intensive fluid dynamics and structural simulations.

Design Space Exploration

Students utilize the AI to explore thousands of hull forms and structural layouts. This moves learning from tedious manual drawing to rapid hypothesis testing and concept validation.

Concept & Theory Integration

Students are tasked with using established theories alongside AI parameters to ensure structural feasibility, verifying bending moments, shear stresses, and safety margins.

3.2.1. OBE Alignment for the Ship Structure Course

In the traditional curriculum, the Ship Structures course relies heavily on final exams and rigid formulas. Initial steps are being taken to transition toward a modern Outcome-Based Education (OBE) framework as shown in Figure.3.

Higher-Order Learning

Rather than just copying cross-section calculations, students use AI to analyze "what-if" scenarios, fostering critical thinking, structural optimization, and analytical skills.

Competency Tracking

Assessments focus on continuous evaluation of competencies rather than rote memorization. Students must demonstrate they understand why the AI made certain structural recommendations.

Industrial Preparedness

Preparing students for the modern maritime industry, where Generative AI and digital transformation are key to smart shipping and sustainable design..

SEKOLAH TINGGI TEKNOLOGI PEKANBARU										
FAKULTAS TEKNIK										
PROGRAM SARJANA TEKNIK MESIN										
RENCANA PEMBELAJARAN SEMESTER (RPS)										
Program Studi	Teknik MESIN			Program	Sesuai			Sesuai		
Buku NIS	MPP13762			Mata Kuliah	Mesin Energi Energi			Mesin Energi Energi		
Sejarah	VI (enam)			Batas SKS	5 SKS			5 SKS		
SKS Prasyarat				Kelas	Kelas			ME Wjaya		
Disusun Oleh	Prof. Jansen Kim, C. Tag, Chik Eng									
Deskripsi RPS	Mata kuliah ini membahas secara komprehensif pada bidang teknik mesin									
Capaian Pembelajaran Lulusan (CPL)	CPL1	Kemampuan konsep dan komunikasi, serta kemampuan analisis (engineering principles) untuk menyelesaikan masalah teknik yang kompleks (engineering problem) pada sistem tenaga (power system).								
	CPL2	Kemampuan dalam melakukan praktik, keterampilan manual dalam menulis dan mengoperasikan alat, mengidentifikasi, merencanakan, dan melaksanakan masalah teknik secara mandiri (autonomous system).								
	CPL3	Mampu mengorganisir, merencanakan, mengimplementasikan dan memonitor pelaksanaan proyek.								
	CPL4	Kemampuan komunikasi verbal dan tertulis untuk menyampaikan informasi pada sistem tenaga (power system) melalui proses perancangan, analisis, implementasi, dan evaluasi berdasarkan prinsip-prinsip teknik.								
Capaian Pembelajaran Mula (CPME)	CPME1	Mampu mengorganisir dan melakukan analisis untuk menyelesaikan masalah teknik yang kompleks pada sistem tenaga.								
	CPME2	Mampu dalam melakukan praktik, keterampilan manual dalam menulis dan mengoperasikan alat, mengidentifikasi, merencanakan, dan melaksanakan masalah teknik secara mandiri.								
	CPME3	Mampu mengorganisir, merencanakan, mengimplementasikan dan memonitor pelaksanaan proyek.								
	CPME4	Mampu berkomunikasi verbal dan tertulis untuk menyampaikan informasi pada sistem tenaga.								
Indikator CPL/CPME/CPME/CPME	CPME1	CPME1.1	CPME1.2	CPME1.3	CPME1.4	CPME1.5	CPME1.6	CPME1.7	CPME1.8	
	CPME2	CPME2.1	CPME2.2	CPME2.3	CPME2.4	CPME2.5	CPME2.6	CPME2.7	CPME2.8	
	CPME3	CPME3.1	CPME3.2	CPME3.3	CPME3.4	CPME3.5	CPME3.6	CPME3.7	CPME3.8	
	CPME4	CPME4.1	CPME4.2	CPME4.3	CPME4.4	CPME4.5	CPME4.6	CPME4.7	CPME4.8	
Uji Penilaian	Uji Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Uji Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Uji Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
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Aspek Penilaian	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
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	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
Aspek Penilaian	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
	Aspek Penilaian	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	

Figure 3: Course Outline: Energy Conversion Machinery course

3.2.2. The OcARI Gen-AI Teaching Materials Assessment

Following the development of the OBE framework, the next step is to conduct assess Teaching Materials Assessment based on OBE of Energy Conversion Machinery course [MPP13762] using the OcARI Gen-AI.



<https://ai.ocari.net/Kampus/STTP/AI/勉強/Minutes>

Figure 6: The OcARI Gen-AI Class Minutes



<https://ai.ocari.net/Kampus/STTP/AI/勉強/Lectures>

Figure 8: The OcARI Gen-AI Lecturers



<https://ai.ocari.net/Kampus/STTP/AI/勉強/SelfStudy>

Figure 7: The OcARI Gen-AI Self Study

3.2.4. The OcARI Gen-AI Lecturers & Assessment

The OcARI Gen-AI Lecturers & Assessment system is powered by speech, text, and image recognition technologies, enabling the AI to automatically handle the learning process—as illustrated in Figure 8—and analyze student answers, as shown in Figure 9. Its primary benefit for students is the ability to learn anytime, anywhere, and on any device.

9. Jaswar Koto. 2026. *Pemanfaatan AI dalam Pendidikan & Analisis Laporan Keuangan*. WEBINAR IAIS DATA SCIENCE SERIES 2025, Indonesia Artificial Intelligence Society (IAIS).
10. Jaswar Koto. 2025. *Artificial Intelligence (AI) dalam Pendidikan*. - Dialog Interaktif Luar Studio Pro 1 RRI Pekanbaru, <https://www.youtube.com/watch?v=9Wg7Jab1T Ug>
11. Jaswar Koto. 2025. *Timbangan AI, Pemkab Kampar Dukung Penuh Inovasi Bisnis Kambing Terpadu Berbasis AI*. <https://mediacenter.kamparkab.go.id/artikel-detail/4701/pemkab-kampar-dukung-penuh-inovasi-bisnis-kambing-terpadu-berbasis-ai>
12. Jaswar Koto. 2025. *Mengenal Sistem Pembelajaran Berbasis AI dengan Metode Outcome Based Education*. Kolaborasi Liputan 6 SCTV-IMDE <https://www.merdeka.com/peristiwa/kolaborasi-liputan-6-sctv-imde-mengenal-sistem-pembelajaran-berbasis-ai-dengan-metode-outcome-based-education-388487-mvk.html?page=2>
13. Yuanyuan Cao, Yitao Liu, Jinwen Lai. (2005). "Leveraging Artificial Intelligence in Outcome-Based Education: A Case Study of Undergraduate Auditing Curriculum." *Advances in Applied Sociology*, 2025, 15(2), 60-74 [https://www.scirp.org/pdf/aasoci2025152_22292171.pdf].
14. N. Pradeesh M.G. Thushara. 2025, *AI-Driven Personalized Learning and Remedial Recommendation through Knowledge Concept-Centric Evaluation*, Digital Object Identifier 10.1109/ACCESS.2025.3638427.
15. Hu Wang, Geng'e Zhang, Zehui Li, Xiaozhe Yang. (2026), "An AI-Enhanced Teaching Framework Integrating OBE and Five Pillars of Education for Project-Based Practical Training." *ICBDIE '26: Proceedings of the 2026 International Conference on Big Data and Informatization Education Pages 1289 - 1294*, <https://doi.org/10.1145/3806980.3807180>.
16. Rongxin Chen, Zongyue Wang, Zhihua Wang, Zhijun Wang (2026), *AI-enabled teaching reform of programming courses based on OBE*. IECA 2026: 2026 3rd International Conference on Informatics Education and Computer Technology Applications Pages 868 - 874, <https://doi.org/10.1145/3802133.3802273>.
17. Jaswar Koto, 2026, *Mengenal Sistem Pembelajaran Berbasis AI dengan Metode "Outcome Based Education"*, Institut Media Digital Emtek, <https://maukuliah.id/universities/institut-media-digital-emtek/articles/mengenal-sistem-pembelajaran-berbasis-ai-dengan-metode-outcome-based-education>.
18. Jaswar Koto. 2026. *Pemanfaatan AI dalam Pendidikan & Analisis Laporan Keuangan*. WEBINAR IAIS DATA SCIENCE SERIES 2025, Indonesia Artificial Intelligence Society (IAIS).
19. Jaswar Koto. 2025. *Artificial Intelligence (AI) dalam Pendidikan*. - Dialog Interaktif Luar Studio Pro 1 RRI Pekanbaru, <https://www.youtube.com/watch?v=9Wg7Jab1T Ug>
20. Jaswar Koto. 2025. *Timbangan AI, Pemkab Kampar Dukung Penuh Inovasi Bisnis Kambing Terpadu Berbasis AI*. <https://mediacenter.kamparkab.go.id/artikel-detail/4701/pemkab-kampar-dukung-penuh-inovasi-bisnis-kambing-terpadu-berbasis-ai>
21. Jaswar Koto. 2025. *Mengenal Sistem Pembelajaran Berbasis AI dengan Metode Outcome Based Education*. Kolaborasi Liputan 6 SCTV-IMDE <https://www.merdeka.com/peristiwa/kolaborasi-liputan-6-sctv-imde-mengenal-sistem-pembelajaran-berbasis-ai-dengan-metode-outcome-based-education-388487-mvk.html?page=2>
22. M. Agung, 2026, *Testimoni The OcARI Gen-AI Teknik Perkapalan UPNVJ*, <https://youtube.com/shorts/xhpVkl0u4ps?si=znQoIHyrqtmrzk>
23. Nabillah Jasmine Anugrah Putri, 2026, *Penggunaan OcARI GEN-AI dalam Matakuliah kekuatan Kapal UPNVJ*, <https://youtu.be/An5caTViFCc?feature=shared>
24. Rasyah Gathan, 2026, *Reveiw Web Ocari Gen-Ai Matakuliah Kekuatan Kapal*, <https://youtu.be/fbPOgVOhcP0?si=CDaDoPKrg323ey6a>
25. Muhammad Haris, 2026, *Review Website AI OCARI (website bantuan belajar) UPNVJ*, <https://www.youtube.com/watch?v=qe7-61E2Cgc>
26. Mulyadi Nur, 2026, *The OcARI Gen-AI*, <https://www.youtube.com/watch?v=qe7-61E2Cgc> <https://www.youtube.com/watch?v=OobRQoddXrA>
27. I Nyoman Maswinara, 2026, *Review dan Testimoni: OcARI Gen-AI untuk Mata Kuliah Kekuatan Kapal*, <https://www.youtube.com/watch?v=lqTrWR5EXuc>
28. David Simare Mare, 2026, *Penggunaan OcARI Gen-AI Dalam Kegiatan Belajar Mahasiswa UPNVJ*, https://www.youtube.com/watch?v=iA2-hH_VC5Y