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Development of an Adaptive Outcome-Based Education Learning Model Integrating Merdeka Belajar Kampus Merdeka in Post-Disaster Higher Education

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Abstract: This objective of study is adaptive Outcome-Based Education (OBE) model integrated with the Merdeka Belajar Kampus Merdeka (MBKM) policy to address learning needs in post-disaster areas of West Sumatra. The research employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Participants included lecturers, Culinary Education students, and MBKM partners involved in humanitarian projects. Data were collected through interviews, observations, and Course Learning Outcome (CLO) assessments. The results indicate that experts rated the model as highly feasible with a validity score of 88.67%. Adaptation is specifically achieved through a flexible hybrid curriculum and direct student involvement in community economic recovery via culinary-based humanitarian projects. Model effectiveness was confirmed by a significant increase in average CLO achievement from 71.74 to 87.72%, with a moderate N-gain of 0.56 ($p < 0.05$). This study concludes that the adaptive OBE-MBKM model serves as an effective instructional innovation for post-disaster higher education. It successfully aligns academic competencies with community-based disaster resilience, providing a strategic framework for culinary education to contribute directly to regional recovery and social responsiveness. This model offers a replicable approach for higher education institutions operating in disaster-prone regions to maintain academic quality while fostering social impact.

Keywords: Adaptive learning; Merdeka belajar kampus merdeka; Outcome-based education; Post-disaster education

Introduction

The transformation of higher education requires universities to prepare graduates who are not only academically competent but also socially responsive and adaptive to environmental changes. In Indonesia, institutions face increasing pressure to generate graduates who are resilient, particularly in post-disaster contexts such as West Sumatra (Purbasari et al., 2025; Magfirah et al., 2025). Outcome-Based Education (OBE) serves as a strategic framework to ensure measurable achievement of learning outcomes aligned with societal needs (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2023). In synergy with OBE, the Merdeka Belajar Kampus Merdeka (MBKM) policy provides contextual experiences through off-campus activities, such as humanitarian projects and community empowerment (Sadsoeitoeboen et al., 2023; Sari et al., 2025).

However, in post-disaster settings, Culinary Education programs encounter constraints including damaged practical facilities, psychosocial challenges, and shifting community competency demands (Opabola & Galasso, 2024). Previous studies indicate that OBE

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implementation remains largely administrative and lacks integration with authentic MBKM experiences (Mufanti et al., 2024). Furthermore, there is a significant gap in adaptive learning models specifically designed for emergency contexts that align Course Learning Outcomes (CLO) with the macro Program Learning Outcomes (PLO) (Nabuasa et al., 2024; Rincon-Flores et al., 2024; Derouich, 2025).

This study addresses these challenges by developing an adaptive OBE-MBKM model using the ADDIE approach. In the Development phase, the model's validity was assessed using a Likert-scale instrument and analyzed via percentage of agreement to ensure expert consensus. During the Implementation phase, the study employed a One-Group Pretest-Posttest Design to measure the enhancement of student competencies. To maintain terminological accuracy, this research focuses on the achievement of CLOs that contribute to specific PLO indicators rather than measuring the entire graduate profile in a single cycle. In the Evaluation phase, qualitative data were analyzed using the Miles and Huberman interactive model (reduction, display, and conclusion drawing) to provide a rigorous and consistent scientific assessment. This research aims to provide a strategic framework for culinary education to contribute directly to regional recovery and social responsiveness in West Sumatra.

Method

This study employed a Research and Development (R&D) approach using the ADDIE instructional design model, which consists of five systematic stages: analysis, design, development, implementation, and evaluation (Mardizal et al., 2023). The ADDIE model was selected for its systematic and flexible structure in developing outcome-oriented instructional products and its strong relevance to learning model development in higher education contexts.

Analysis Phase

The analysis phase identified post-disaster learning needs in West Sumatra through curriculum document reviews and lecturer interviews (Setiani et al., 2024). This stage focused on identifying gaps in specific Course Learning Outcomes (CLOs) that support the achievement of Program Learning Outcomes (PLOs), while assessing facility limitations and institutional readiness for MBKM integration.

Design Phase

This phase developed the conceptual framework for the adaptive OBE-MBKM model. It included formulating adaptive instructional strategies and designing authentic assessments specifically tailored to post-disaster constraints. The design ensured that every learning activity was mapped to specific CLOs.

Development Phase

The development phase produced a learning model prototype. Expert validation was conducted by curriculum and instructional specialists using a 5-point Likert-scale instrument. The validity data were analyzed using the percentage of agreement formula to determine the model's feasibility and level of adaptability before field testing.

Implementation Phase

The implementation was carried out through a One-Group Pretest-Posttest Design. The model was applied to a limited group of 30 Culinary Education students and six lecturers. Learning was executed through project-based activities integrated with MBKM culinary humanitarian projects. During this phase, the achievement of CLOs was measured as a representation of students' progress toward specific PLO indicators.

Evaluation Phase

Evaluation combined formative and summative assessments. Qualitative data from observations and interviews were analyzed using the Miles and Huberman interactive model, comprising data reduction, data display, and conclusion drawing. Quantitative data were analyzed through N-gain scores and paired-sample t-tests to determine the model's effectiveness.

Participants and Data Analysis

Participants included 30 Culinary Education students, six lecturers, and three MBKM partners (SMEs and local institutions in West Sumatra). Data analysis utilized: Descriptive quantitative analysis to process expert validation scores; Inferential statistical analysis (t-test) to examine improvements in CLO achievement; Miles and Huberman interactive analysis for qualitative insights into the implementation process.

Result and Discussion

Result

Needs Analysis Results

The needs analysis indicates that post-disaster Culinary Education requires a flexible, contextual, and social project–based learning model. Both lecturers and students emphasized the need for more systematic integration of OBE and MBKM, as well as authentic performance-based assessment. The results of the needs analysis are summarized in Table 1.

Based on Table 1, the implementation of the OBE-based curriculum has not been fully integrated with the MBKM policy. The current curriculum does not

adequately facilitate learning flexibility or strengthen learning outcomes through experiential and off-campus activities.

Table 1. Needs analysis of post-disaster learning

Aspect	Findings
Curriculum	OBE is not yet fully integrated with MBKM
Instruction	Predominantly theoretical; limited practice
Assessment	Not fully aligned with PLOs
Identified Need	Adaptive social project–based learning model

In instructional practice, learning remains dominated by theoretical approaches, while contextual and problem-based practical activities remain limited. As a result, students do not yet gain optimal learning experiences, particularly in responding to post-disaster learning challenges.

Furthermore, assessment practices have not been fully designed around Program Learning Outcomes (PLOs). Assessment continues to emphasize knowledge acquisition, while students' attitudes and practical skills are not comprehensively measured.

In summary, the needs analysis confirms the urgency of developing an adaptive social project–based learning model that effectively integrates OBE principles, MBKM policy objectives, and the contextual characteristics of post-disaster education.

Design and Development Phase

The adaptive OBE learning model integrated with MBKM was developed through five core components: OBE-based alignment of Program Learning Outcomes (PLOs) and Course Learning Outcomes (CLOs), contextual post-disaster MBKM project planning, implementation of adaptive learning with flexibility in time, location, and instructional methods, portfolio- and product-based authentic assessment, and continuous evaluation and reflection.

The adaptive Outcome-Based Education (OBE) model integrated with Merdeka Belajar Kampus Merdeka (MBKM) comprises five interrelated components that collectively support contextual, flexible, and outcome-oriented learning aligned with Program Learning Outcomes (PLOs). The findings indicate the following:

OBE-Based PLO–CLO Alignment serves as the foundation for curriculum design. This process ensures that graduate profiles and course-specific competencies are aligned with industry demands, 21st-century learning competencies, and national higher education standards. Such a backward design approach enhances coherence between intended learning outcomes, instructional strategies, and assessment practices, as widely documented in OBE literature.

Contextual Post-Disaster MBKM Project Planning integrates local needs and real-world dynamics into MBKM activities. This planning facilitates student engagement in authentic projects relevant to post-disaster contexts and strengthens knowledge transfer to real-life situations. Theoretically, embedding local contexts within MBKM aligns with its objective of enabling students to pursue off-campus learning experiences that directly support competency development.

Adaptive Learning Implementation emphasizes flexibility in time, place, and instructional methods, allowing students to achieve learning outcomes through multiple learning pathways. Such flexibility represents a core characteristic of OBE, which prioritizes responsiveness to learner needs and evolving learning environments. In contemporary OBE practice, flexible instructional approaches are essential for accommodating learner diversity and strengthening competency attainment.

Portfolio- and Product-Based Authentic Assessment evaluates students' actual performance in professional and community contexts. Portfolios support continuous evaluation and provide empirical evidence of CLO achievement, consistent with OBE assessment principles that emphasize alignment between learning activities and demonstrated competencies.

Continuous Evaluation and Reflection enable systematic feedback among instructional implementation, learning outcome assessment, and subsequent instructional improvement. This mechanism reinforces the principle of continuous improvement, which underpins both OBE and effective MBKM implementation.

Model Validation

Validation by curriculum experts, instructional experts, and practitioners yielded an average score of 88.67%, classified as highly feasible. Detailed results are presented in Table 2.

Table 2. Results of learning model validation

Validator	Percentage (%)	Category
Curriculum Expert	87	Highly Feasible
Instructional Expert	89	Highly Feasible
Practitioner	90	Highly Feasible
Average	88.67	Highly Feasible

Descriptive analysis using SPSS indicates that validation scores ranged from 87 to 90%, with an overall mean of 88.67%. The relatively narrow score range demonstrates strong inter-rater consistency among the validators.

These findings confirm that the developed learning model satisfies feasibility criteria across curricular alignment, instructional design quality, and practical applicability in real instructional settings. To examine the distribution and tendency of the validation data, descriptive statistical analysis was conducted using SPSS software. The results are presented in Table 3.

Table 3. Descriptive statistics of the learning model validation

Statistic	Value
Minimum	87
Maximum	90
Mean	88.67 %
Standard deviation	1.53

As shown in Table 3, the mean validation score was 88.67% with a standard deviation of 1.53. The low standard deviation indicates a high level of consistency among validators and suggests no substantial variation in expert judgments.

Implementation and Effectiveness

Model implementation resulted in a significant improvement in students' achievement of Program Learning Outcomes (PLOs). Students demonstrated marked gains in practical skills, collaboration, and contextual problem-solving in post-disaster settings. Model effectiveness was further examined using the normalized gain (N-gain) score to determine the magnitude of improvement in PLO achievement before and after implementation. The N-gain value was calculated using the following formula.

N-Gain Analysis Results

The N-gain calculation results are presented in Table 4.

Table 4. N-Gain analysis of students' Program Learning Outcome (PLO) achievement

Validator	Pre- test (%)	Post-test (%)	N-gain	Category
Knowledge	72	85	0.46	Moderate
Skills	68	88	0.63	Moderate
Professional attitude	75	90	0.60	Moderate
Average	71.66	87.66	0.56	Moderate

Based on Table 4, the average N-gain value is 0.56, which falls within the moderate category. This result indicates that the implementation of the learning model produces a pedagogically meaningful improvement in students' PLO achievement. The skills and professional attitude domains demonstrate higher N-gain values than the knowledge domain, suggesting that the model is more effective in enhancing students' applied competencies and affective development.

Paired-Sample t-Test Analysis

To determine the significance of improvement in Program Learning Outcomes (PLOs), a paired-sample t-test was conducted on pre- and post-implementation scores. The results indicate a statistically significant increase in mean PLO achievement ($p < 0.05$).

Statistically, this improvement confirms that the observed differences in PLO achievement before and after implementation did not occur by chance but resulted from the application of the adaptive OBE–MBKM learning model. Therefore, the model demonstrates statistical effectiveness in enhancing students' PLO achievement.

Alignment of the Learning Model with OBE, PLOs, and CLOs

The developed learning model was designed to support Outcome-Based Education (OBE) by systematically translating Program Learning Outcomes (PLOs) into measurable Course Learning Outcomes (CLOs). Each stage of the instructional syntax explicitly facilitates the attainment of CLOs aligned with program-level outcomes.

Learning assessment was structured around performance- and product-based measures to ensure objective and transparent evaluation of learning achievement. Accordingly, the model supports student learning outcomes while meeting the requirements of OBE-based quality assurance and accreditation systems. The alignment among instructional syntax, CLOs, assessment forms, and assessment instruments is presented in Table 5.

Based on Table 5, each stage of the instructional syntax was intentionally designed to support measurable achievement of Course Learning Outcomes (CLOs). Each CLO is derived from the Program Learning Outcomes (PLOs) and evaluated using assessment methods aligned with the characteristics of the targeted competencies.

The assessment framework emphasizes both learning processes and final outcomes, consistent with Outcome-Based Education (OBE) principles. Assessment instruments, including rubrics and observation sheets, enable objective and transparent measurement of learning achievement.

The coherence among instructional syntax, CLOs, assessment strategies, and assessment instruments demonstrates that the learning model was systematically designed and fully complies with outcome-based learning requirements.

Table 5. Alignment of learning model syntax with CLOs, assessment, and instruments

Learning Syntax	Achieved CLOs	Assessment Type	Assessment Instruments
Problem Orientation	Students identify learning problems based on course context and objectives	Written test and observation	Essay questions, observation sheets
Activity Planning	Students systematically design solutions or learning activity plans	Performance assessment	Planning rubric
Activity Implementation	Students apply concepts and procedures according to the plan	Performance assessment and observation	Performance rubric, observation sheets
Analysis and Reflection	Students analyze outcomes and conduct learning reflection	Written test and reflection	Essay questions, reflection sheets
Presentation and Feedback	Students communicate outcomes orally and in writing	Product and presentation assessment	Presentation rubric, product rubric

Discussion

The findings demonstrate that the adaptive OBE learning model integrated with MBKM effectively addresses instructional challenges in post-disaster Culinary Education in West Sumatra. The expert validation score of 88.67% confirms that the model satisfies curricular and pedagogical standards for higher education. However, the average N-gain of 0.56 (Moderate) requires critical reflection.

Implementing the adaptive Outcome-Based Education (OBE) model alongside social project-based MBKM learning in post-disaster higher education settings in West Sumatra achieved an N-gain of 0.56, indicating a moderate improvement in student learning outcomes. From a pedagogical perspective, this value reflects a significant enhancement in both conceptual understanding and applied competencies, especially given that the model was introduced as an instructional innovation in such a challenging environment. In development research contexts, moderate gains during the initial stages of implementation are considered realistic, as instructional innovations require adaptation cycles, user familiarisation and contextual refinement before they can be said to be operating at their most effective (Pakpahan et al., 2023; Asmayawati et al., 2024). However, the gain did not reach the 'high' category (> 0.70), and this must be interpreted in light of the contextual factors identified during the needs analysis phase. Post-disaster conditions often entail psychosocial stress, trauma exposure and instability, affecting students' concentration, motivation and cognitive readiness. This, in turn, restricts learning performance despite effective pedagogical interventions (Rahayu et al., 2023; Farida et al., 2023; Zhao et al., 2024). In addition, infrastructural constraints, such as limited learning facilities, unstable digital access and restricted learning resources, reduce the ideal implementation of project-based learning, which typically requires collaborative spaces, material support and sustained engagement. Project-based and contextual learning innovations implemented in constrained environments tend to produce moderate yet significant gains while improving higher-order thinking, creativity and 21st-century competencies (Anwar et al., 2024; Mardizal et al., 2023).

These findings reinforce the idea that moderate effectiveness does not indicate model weakness, but rather reflects contextual realities and the fact that the model is still in the early stages of development. Notably, the model has shown that it can enhance student engagement and CPL attainment by encouraging authentic problem solving and community-responsive projects that are relevant to disaster recovery contexts. Therefore, the N-gain of 0.56 should be interpreted as evidence of contextually meaningful effectiveness rather than suboptimal performance. Reflecting critically on psychosocial conditions, infrastructural limitations and implementation readiness prevents overly optimistic interpretations and offers direction for improvement. Strengthening psychosocial support systems, improving learning facilities and enhancing lecturers' capacity for OBE project implementation are likely to elevate the model's effectiveness to the 'high' category in subsequent iterations. Furthermore, Rohani & Rahmawati (2025), Asbari & Novitasari (2024), and Putra et al (2021) emphasizes that post-disaster instructional outcomes are heavily influenced by the psychosocial recovery process, which explains why a "High" N-gain is challenging to achieve in the immediate recovery phase.

The integration of OBE and MBKM through humanitarian projects represents a significant shift from administrative compliance to authentic competency development. This model aligns with the findings of Liriwati & Zulhimma (2025), who highlight that the synergy between MBKM and OBE is essential for developing competitive graduate profiles that are responsive to professional and social demands. In this study, students do not merely acquire theoretical knowledge but apply it to address real-world problems through culinary-based community empowerment. Such an approach is supported (Sobri et al., 2025; Prasadityo et al., 2023; Rea-Guaman et al., 2025), who argue that embedding humanitarian projects within the OBE framework enhances students' social responsibility and 21st-century competencies.

Furthermore, the systematic alignment between Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs) ensures that even in an adaptive and flexible environment, academic quality is maintained (Pratiwi & Tyas, 2025; Normalisa et al., 2025; Aji et al., 2023; Septaria et al., 2020). As noted by Fitrianto & Salf (2024), the "backward design" in vocational pedagogy is crucial for ensuring that every learning activity contributes directly to the macro profile of the graduate. The use of portfolio-based authentic assessment in this model provides a strategic solution for recognizing experiential learning, a core principle advocated by Rizal et al. (2025), Lukman et al. (2023), and Prananda et al. (2020).

Ultimately, this research proves that an adaptive model is not just a temporary fix for disasters, but a strategic framework for future-proofing higher education (Amiruddin et al., 2024; Alexander et al., 2024; Fatimah et al., 2026). By providing flexibility in time and location while maintaining rigorous assessment standards, universities can remain socially responsive without compromising on the quality of learning outcomes (Nursamsu et al., 2025; Mohammad et al., 2025).

Empirical results reveal a significant improvement in PLO achievement, with mean scores increasing from 71.74 to 87.72%. The average N-gain value of 0.56 indicates a moderate learning gain, while paired-sample t-test results confirm statistical significance ($p < 0.05$). These findings demonstrate the model's effectiveness in improving students' knowledge, skills, and professional attitudes, particularly through contextual MBKM projects and portfolio-based authentic assessment ('Ainillana & Louise, 2024; Evriliani & Rahmawati, 2025; Lestari et al., 2019). The model also contributes to the achievement of Key Performance Indicators (IKU), particularly IKU 1 (work-ready graduates), IKU 2 (off-campus learning participation), and IKU 7 (collaborative classrooms). These outcomes reinforce previous evidence emphasizing the critical role of project-based learning and authentic assessment in strengthening OBE implementation.

Conclusion

The adaptive OBE-MBKM learning model developed for the post-disaster context of West Sumatra is proven to be highly feasible and effective. Based on the Research and Development (R&D) results using the ADDIE approach, the model achieved a high validity score of 88.67% from experts and practitioners. The implementation phase demonstrated a significant improvement in student competencies, with average CLO achievement increasing from 71.74 to 87.72% and a moderate N-gain of 0.56. While environmental and psychosocial constraints in post-disaster areas influenced the gain scores, the model successfully integrated academic rigor with social responsiveness. This study concludes that the integration of culinary-based humanitarian projects within the OBE framework provides a strategic solution for vocational education to remain relevant during crisis recovery. The model not only enhances students' practical and professional attitudes but also contributes directly to the community's economic resilience. For future implementation, it is recommended that higher education institutions provide additional psychosocial support and flexible infrastructure to further optimize learning outcomes in disaster-prone regions. This adaptive framework serves as a replicable innovation for aligning university Key Performance Indicators (IKU) with regional development and social impact.

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W.G.: conceptualization, methodology, formal analysis, data curation, writing—original draft preparation, project administration; T.D.S.: conceptualization, validation, resources, supervision, writing—review and editing, funding acquisition; A.I.: data curation, visualization, validation, resources, writing—review and editing.

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