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Benchmarking CO-AIMS with Peer OBE Systems: A Comparative Study of Academic Information Management Tools

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ABSTRACT

The growing adoption of Outcome-Based Education (OBE) in higher education has intensified the need for academic information systems that would be able to monitor Program Outcomes (POs) effectively, enable Continuous Quality Improvement (CQI), and assist with transparent evidence for accreditation. While institutions have developed or availed digital tools in majority, their responsiveness and effectiveness are still largely disparate. This study contrasts the College of Engineering Academic Information Management System (CO-AIMS) developed at UiTM Pasir Gudang with similar peer OBE-support systems like eOutcomes at Taylor's University, the Universiti Teknologi Malaysia OBE system, SmartOBE, and the OBE-Support platform at Universitas Indonesia. Taking a comparative methodology with six evaluation criteria—functionality, data analytics, user experience, CO-PO mapping efficiency, CQI integration, and scalability—this study draws conclusions based on system documentation, literature data, and academic staff feedback. Its findings show that CO-AIMS presents strong points in usability, PO attainment tracking, and academic advisory support through reduced dashboards and easy reporting options that reduce lecturer workload. However, gaps also emerged in terms of interoperability with Learning Management Systems (LMS), scalability beyond one department, and the absence of AI-driven predictive analytics characteristic of newer systems. By systematic comparison of CO-AIMS with peer systems, this study contributes a benchmarking structure finding both strengths and limitations to generate actionable recommendations for system improvement and institutional planning. The results underscore the importance of continued progress to ensure OBE-friendly systems remain flexible to address evolving accreditation standards and the digital revolution in tertiary education.

1. INTRODUCTION

The overview of Outcome-Based Education (OBE) has changed the landscape of higher education, even more in engineering programs that are required to align academic practice with clearly defined Program

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Outcomes (POs). Institutions are now compelled to provide evidence of learners' learning accomplishments, establish Continuous Quality Improvement (CQI) mechanisms, and render the evaluation and assessment of learning outcomes more effective (Popovic, 2013). In response, many universities have developed or adopted academic information systems designed to manage, monitor, and report student attainment data (Kivunja, 2014). However, despite the proliferation of such systems, there exists limited comparative analysis that benchmarks their capabilities, user experience, and alignment with OBE best practices.

The College of Engineering Academic Information Management System (CO-AIMS), developed at the School of Electrical Engineering, Universiti Teknologi MARA (UiTM) Pasir Gudang (Othman et al., 2024), was introduced to address specific institutional needs for PO tracking, cohort-level analysis, and academic advisory support. Built using the Rapid Application Development (RAD) model (Safiudin et al., 2020), CO-AIMS integrates data visualization tools and customizable reports to facilitate informed decision-making among academic staff. While the system has demonstrated effectiveness in improving transparency, advisory efficiency, and PO documentation, questions remain regarding how it compares with other OBE systems in similar institutional contexts.

Benchmarking academic systems is an essential strategy for identifying areas for improvement and innovation. According to (Al-fraihat et al., 2020), a system’s value is increasingly measured by its usability, integration, and ability to support strategic academic goals. As such, this study aims to benchmark CO-AIMS against peer systems implemented in other engineering faculties. The comparison focuses on key performance indicators such as functionality, data analytics capability, user experience, CO-PO mapping efficiency, CQI integration, and scalability. Through this analysis, the paper seeks to highlight CO-AIMS’s strengths, uncover potential areas for enhancement, and provide actionable insights for institutions aiming to strengthen their digital academic infrastructure in support of OBE.

The flowchart in Fig. 1 illustrates the operational workflow of the College of Engineering Academic Information Management System (CO-AIMS). The process begins with lecturers inputting assessment data, followed by automated Course Outcome (CO) to Program Outcome (PO) mapping. The system then generates dashboards for PO attainment and cohort-level analysis, which subsequently support CQI reporting and academic advisory functions.

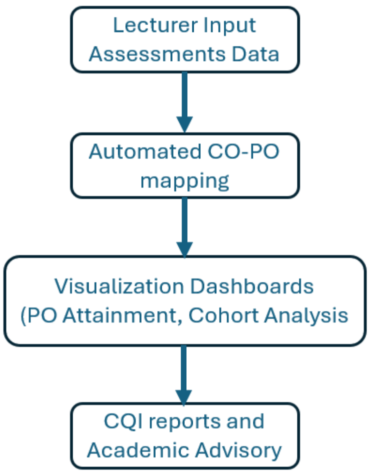

Fig. 1. CO-AIMS workflow

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2. LITERATURE REVIEW

The adoption of Outcome-Based Education (OBE) has necessitated the development of digital tools that track Course Outcomes (COs) and Program Outcomes (POs). Early systems, such as macro-enabled worksheets, offered automation of attainment calculations and simplified reporting, but these solutions lacked scalability, adaptability, and real-time analytics (Andal Gamboa & Namasivayam, 2013). While effective for small-scale implementation, such tools were not sustainable for accreditation-driven institutions that require robust evidence and continuous improvement.

Institutions have since developed more comprehensive systems. The OBE system at Universiti Teknologi Malaysia (UTM) emphasizes dashboards and automated CQI reporting to enhance transparency and reduce manual workload (Sanusi et al., 2022). Similarly, Universitas Indonesia's OBE-Support System integrates with national accreditation standards, demonstrating scalability and institutional customization (Asbari & Nurhayati, 2024). These examples illustrate how institutional priorities—such as compliance, reporting efficiency, and curriculum alignment—shape system design. However, they also reveal a lack of standardization across systems, making inter-institutional comparison difficult.

Recent advances leverage artificial intelligence (AI) and predictive analytics to enhance the functionality of OBE platforms. SmartOBE, for example, integrates AI to forecast attainment trends and improve decision-making (Liu et al., 2025). Similarly, (Sengupta & Das, 2023) demonstrated how natural language processing (NLP) could automate CO-PO mapping with greater precision than manual or rule-based methods. Mobile-based systems in the Philippines and India further expand accessibility, allowing faculty to engage with OBE processes beyond traditional desktop environments (Aragón et al., 2020; Evardo, 2023). These innovations indicate a global shift toward intelligent, adaptive, and user-friendly platforms.

Despite progress, several limitations remain unresolved. First, interoperability with Learning Management Systems (LMS) continues to be a barrier, as many platforms operate as stand-alone tools rather than integrated ecosystems (Mistamiruddin & Mohamad Nasri, 2024). Second, CQI functions often remain semi-manual, requiring academic staff to interpret data and formulate improvement plans, rather than receiving automated, data-driven recommendations (Mohd Noor et al., 2024). Third, user adoption challenges persist: while some systems provide advanced analytics, their complex interfaces discourage widespread use by faculty. Finally, the literature emphasizes accreditation needs for traceability, yet current systems vary widely in how they document and standardize evidence (Namoun et al., 2018).

Although diverse systems exist, most research remains focused on single-institution case studies that highlight design or implementation (Kivunja, 2014). Few studies systematically compare OBE-supportive systems across multiple criteria. As (ALBayati, 2025) argue, benchmarking is essential for identifying best practices and evaluating system effectiveness in different contexts. (Dufault et al., 2025) further highlight the need for real-time dashboards to support timely CQI, yet there is little comparative evidence on how such features vary across platforms.

In summary, academic information systems supporting OBE have progressed from simple spreadsheets to AI-enhanced, mobile-compatible platforms. However, persistent challenges—such as limited interoperability, incomplete CQI automation, inconsistent user adoption, and lack of standardization—hinder their effectiveness. Importantly, comparative benchmarking studies remain scarce, leaving institutions without clear insights into which features represent best practice.

This study addresses these gaps by benchmarking the College of Engineering Academic Information Management System (CO-AIMS) against peer OBE systems. By focusing on functionality, analytics, user experience, CO-PO mapping efficiency, CQI integration, and scalability, the study contributes both a comparative framework and actionable insights for enhancing digital academic infrastructure in support of OBE.

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In addition, while numerous studies have documented the design and implementation of OBE-supportive systems, most remain focused on single-institution case studies without cross-institutional benchmarking. Existing platforms also face persistent challenges such as limited interoperability with Learning Management Systems (LMS), semi-manual CQI processes, and inconsistent user adoption.

The recent advances in educational technology have extended the capabilities of OBE-support systems with learning analytics, artificial intelligence (AI) and data-driven decision-making. In recent years, predictive analytics has been widely implemented in modern academic information systems to identify students who are at risk of poor academic performance for early intervention and targeted support (Liu et al., 2025). Furthermore, learning analytics dashboards have been proved to enhance the effectiveness of Continuous Quality Improvement (CQI) by providing real-time information on student attainment and programme performance trends (Dufault et al., 2025)Another significant area of development is the integration of Learning Management Systems (LMS) with OBE platforms. By integrating LMS with OBE platforms, institutions can ensure seamless data exchange, reduce the need for manual data entry, and enhance institutional efficiency (Mistamiruddin & Mohamad Nasri, 2024). Such developments indicate a move away from traditional reporting systems to intelligent and integrated academic management ecosystems that are able to support evidence-based educational decision-making.

This study contributes novelty by providing a systematic benchmarking of CO-AIMS against peer OBE systems using six evaluation criteria: functionality, data analytics, user experience, CO-PO mapping efficiency, CQI integration, and scalability. The findings not only highlight CO-AIMS's comparative strengths in PO tracking and advisory support but also identify clear opportunities for enhancement, particularly in AI-driven analytics and interoperability. This dual emphasis on comparative analysis and actionable insights distinguishes the study from prior works and offers a replicable framework for institutions seeking to modernize their academic information management infrastructure.

3. METHODOLOGY

This study used comparative benchmarking approach to compare the College of Engineering Academic Information Management System (CO-AIMS) with some of its selected peer Outcome-Based Education (OBE) systems implemented in other engineering colleges. Benchmarking was the research design employed since it makes systematic evaluation across contexts and elucidates best practices and loopholes that would otherwise remain hidden in single-institution studies.

The benchmarking model in Fig. 2 was developed with established models to assess digital learning and academic information systems (Al-fraihat et al., 2020). Six key criteria were determined as the foundation of comparison: (1) functionality of the system, (2) capacity for data analytics, (3) user interface, (4) capability of CO-PO mapping, (5) integration with CQI, and (6) scalability and interoperability. These criteria were selected because they represent the core requirements of academic information systems supporting OBE implementation and accreditation processes.

Data were collected from three primary sources. First, institutional documents, system manuals, user guides, and CQI reports were analysed to evaluate CO-AIMS. Second, peer systems were assessed through published journal articles, conference papers, technical reports, and publicly available documentation. Third, empirical feedback was obtained from 15 academic staff members from the Faculty of Electrical Engineering, UiTM Pasir Gudang, who had direct experience using CO-AIMS. The respondents consisted of programme coordinators, academic advisors, OBE committee members, and lecturers with between three and fifteen years of OBE implementation experience. Data were collected using a mixed-documentary and feedback approach. The survey responses were analysed using descriptive statistics. Mean scores were calculated to determine the overall level of agreement for each evaluation item, while standard deviation values were used to assess the consistency of respondents' opinions. The interpretation of mean scores was

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based on a five-point Likert scale, where higher mean values indicate more favourable perceptions of the system.

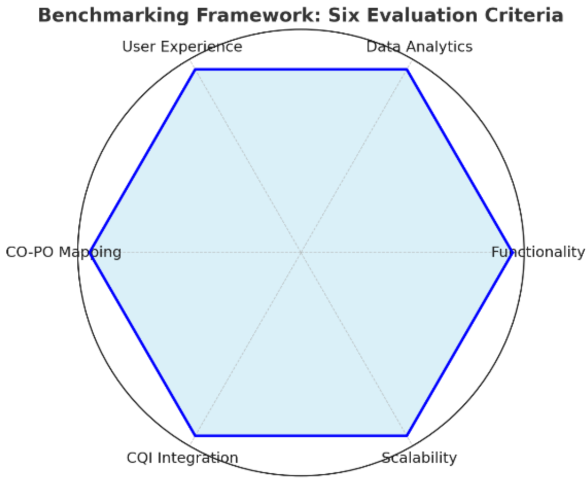

Fig. 2. Benchmarking framework

A matrix-based benchmarking approach was employed to compare all systems against the six evaluation criteria. Each criterion was rated using a five-point scale, where 1 represented very limited capability and 5 represented excellent capability. The ratings were assigned through triangulation of evidence obtained from literature sources, institutional documents, and user feedback. For CO-AIMS, empirical observations from users were incorporated into the evaluation, whereas peer-system assessments were primarily derived from documented evidence reported in the literature. To improve reliability, the benchmarking results were reviewed collectively by the research team and cross-validated against available documentation before final scores were assigned. The resulting benchmarking matrix enabled both quantitative comparison and qualitative interpretation of system strengths, weaknesses, and opportunities for enhancement.

Table 1. Scoring criteria of benchmarking

Score	Interpretation
1	Very limited capability
2	Basic Capability with significant limitations
3	Moderate capability meeting minimum requirements
4	Strong capability with minor limitations
5	Excellent capability with advanced features

The benchmarking evaluation applied the following scoring criteria as shown in Table 1 above. To assess the capabilities of CO-AIMS and peer OBE systems on the six benchmarking dimensions, a five-point rating scale was used for consistency and transparency. Higher scores represent more mature and functional systems, and lower scores represent limited implementation or capabilities. The scoring framework provided a way to systematically compare systems and reduced the subjectivity of the evaluation process. The triangulation of evidence from the literature, system documentation and user feedback, made

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possible using well-defined levels of performance, further enhanced the reliability of the benchmarking process.

Table 2. Data sources for benchmarking

System	Evaluation Source
CO-AIMS	System documentation, CQI reports, user surveys, interviews
eOutcomes	Published literature and technical reports
UTM OBE System	Published literature and institutional documentation
SmartOBE	Published literature
OBE-Support	Published literature and technical reports

Table 2 presents the data sources employed in the benchmarking exercise. In order to improve the validity of the comparative evaluation several sources of evidence were used. CO-AIMS evaluations used institutional documentation, CQI reports, user surveys, and staff interviews to obtain operational and user perspective insights. On the other hand, peer systems have been evaluated mainly on published journal articles, conference proceedings and publicly available technical documentation due to limited access to their internal systems. Data triangulation and the credibility of the benchmarking results were increased using multiple data sources, reducing the reliance on a single source of information.

The benchmarking findings were derived from a combination of empirical evidence (CO-AIMS user surveys and interviews), expert judgment from experienced academic staff involved in OBE implementation, and literature synthesis from published studies describing peer OBE systems. This mixed-source approach provided a balanced evaluation while acknowledging the limitations associated with restricted access to proprietary institutional systems.

4. RESULTS AND DISCUSSION

Benchmark analysis revealed that CO-AIMS has a variety of important strengths over peer OBE-supporting systems. At the system-functionality level, CO-AIMS can properly facilitate PO attainment tracking, cohort-level analysis, and academic advisory processes successfully. Its simplicity reduces lecturer workload whilst ensuring compliance with accreditation needs. These functions make CO-AIMS an ideal system for institutional reporting. But unlike more sophisticated systems such as SmartOBE, CO-AIMS do not have predictive functions based on the application of artificial intelligence to the early intervention of student performance.

In terms of data analytics capability, CO-AIMS provides dashboards and visualizations that allow academic staff to monitor trends in performance and generate reports for decision-making. Even though these functionalities were highly valued by UiTM Pasir Gudang staff because they are easy and easy to interpret, they are yet static visualizations.

A total of 15 academic staff members as in Table 3 and 4 participated in the user evaluation survey. The respondents comprised programme coordinators, academic advisors, OBE committee members, and lecturers from the Faculty of Electrical Engineering, UiTM Pasir Gudang. All respondents had direct experience using CO-AIMS for Program Outcome monitoring, Continuous Quality Improvement (CQI) reporting, and academic advisory activities. Their experience in Outcome-Based Education implementation ranged from one to more than seven years, providing diverse perspectives on system usability and effectiveness.

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Table 3. Respondent profile (n=15)

Category	Frequency	Percentage (%)
Programme Coordinator	3	20.0
Academic Advisor (PA)	4	26.7
OBE Committee Member	3	20.0
Lecturer	5	33.3
Total	15	100%

Table 4. Experience in OBE implementation

Experience	Frequency	Percentage (%)
1–2 years	3	20.0
3–5 years	7	46.7
More than 5 years	5	33.3
Total	15	100%

Table 5. Academic staff evaluation of CO-AIMS

Statement	Mean	SD
CO-AIMS simplifies PO attainment monitoring.	4.53	0.52
CO-AIMS reduces manual workload in OBE reporting.	4.47	0.64
The system interface is user-friendly and easy to navigate.	4.60	0.51
CO-AIMS improves efficiency of CO-PO mapping.	4.40	0.63
Dashboard visualizations support decision-making.	4.33	0.62
CO-AIMS facilitates CQI documentation.	4.27	0.70
Integration with other university systems should be improved.	4.67	0.49

(5-point Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree)

From Table 5, it shows that the system is perceived positively with mean scores of all evaluation items greater than 4.0. System integration improvement requirements was rated as the highest (Mean = 4.67) aspect indicating that users perceive the need for better interoperability with other institutional platforms. High scores were also observed for user-friendliness (Mean = 4.60), PO attainment monitoring (Mean = 4.53), and workload reduction (Mean = 4.47) confirming that CO-AIMS is effective to support daily activities related to OBE. These findings corroborate the benchmarking results which highlighted usability, PO tracking and academic advisory support as the key strengths of the system.

On the other hand, the respondents expressed relatively lower confidence in the institution-wide scalability, which indicates that future development should be geared towards expanding the interoperability and deployment capabilities beyond the Faculty of Electrical Engineering. In summary, the survey results provide empirical evidence for the benchmarking results and show that CO-AIMS is seen in a positive light by the key users and identifies opportunities for future improvement.

By contrast, peer systems like UTM's OBE platform and SmartOBE enable real-time analysis and semi-automated CQI planning that facilitate more anticipatory responses to student learning shortfalls. This

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implies that CO-AIMS, while adequate, may be enhanced with the incorporation of real-time data flow and predictive analytics.

From the perspective of the users, employee feedback confirmed CO-AIMS to be easy to use, requiring minimal training and having simple navigation. This contrasts with tools such as OBE-Support, which some studies have reported being hard to install due to complex workflows. Ease of use in CO-AIMS is therefore a relative strength in so far as ease of use remains a major trigger for faculty adoption. But simplicity as a virtue could also limit higher-order functionality and leave the necessity of additional versions to find a balance between useability and more sophisticated features.

The test of CO-PO mapping efficiency revealed that CO-AIMS automates most of the mapping function, reducing manual labor and improving precision. This is particularly important in engineering education since various courses and cohorts must be mapped multiple times. However, advancements in AI-based approaches, like NLP-enabled mapping (Sengupta & Das, 2023) offer much higher accuracy and flexibility. Likewise, when coupling CO-AIMS to CQI, it helps in the creation of systematic reports but compels lecturers to manually interpret data and suggest improvement actions. This contrasts with UTM's OBE system, which boasts automated advice capabilities that accelerate the CQI cycle and could be made solid with added automated advisory components.

Finally, the scalability and interoperability analysis revealed that CO-AIMS remains localized in the Faculty of Electrical Engineering at UiTM Pasir Gudang. While it can theoretically be scaled institution-wide, the current limitation on interoperability with Learning Management Systems (LMS) such as Moodle or Canvas hinders its scalability. Peer systems such as OBE-Support have been more integrated between faculties and platforms, making institutional uptake simpler. This serves to emphasize the need for CO-AIMS to improve interoperability in future development cycles to meet new global standards.

Overall, the benchmarking results position CO-AIMS on a stage where it is a high-ranking system for usability, PO tracking, and academic advisory service but one requiring targeted improvement in predictive analytics, CQI automation, and institutional scalability. The findings reinforce the assertion that while CO-AIMS is a solid institutional instrument, ongoing improvement needs to be driven to align it with the cutting-edge best practices in OBE-supportive systems.

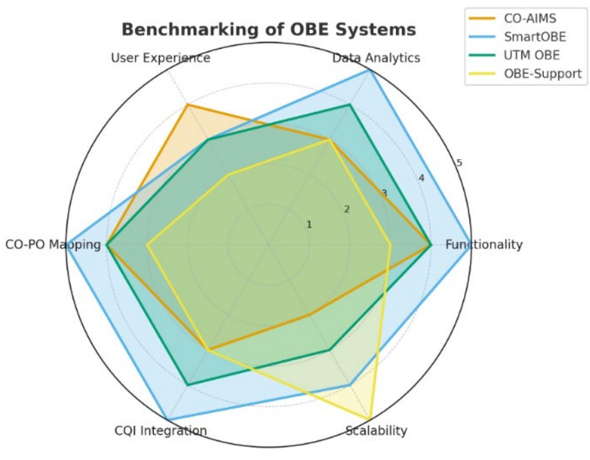

Fig. 3. Benchmarking of OBE system

Fig.3 is a radar chart illustrating benchmarking comparison of CO-AIMS versus peer OBE systems (SmartOBE, UTM OBE, and OBE-Support). Overall, CO-AIMS shows its strength in usability, advisory

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support, and monitoring PO, and it is an institutional resource. It should be further developed compared to peers on AI analytics, interoperability, and automation of CQI processes. Table 6 summarizes performances on six benchmarking dimensions, where CO-AIMS is demonstrated to have competitive advantage (e.g., user experience and CO-PO mapping) and peers are better (e.g., AI-powered analytics and scalability).

Table 6. Summary of benchmarking

Criteria	**CO-AIMS**	**Peer Systems**	**Comparative Position**
Functionality	Strong in PO tracking, advisory	SmartOBE offers predictive tools	Competitive but less advanced
Data Analytics	Clear dashboards, static reports	UTM OBE system, SmartOBE real-time analytics	Adequate, needs real-time integration
User Experience	High usability, minimal training	Some peers complex to adopt	Advantage in simplicity
CO-PO Mapping	Automated, efficient	AI-based systems more precise	Good baseline, potential AI adoption
CQI Integration	Manual report input	Automated CQI in peers	Needs improvement
Scalability	Localized deployment	OBE-Support scalable	Limited scalability

The benchmarking results provide useful insights into the strengths and improvement opportunities of CO-AIMS, but some limitations need to be acknowledged. The assessment of peer OBE systems was mainly done by using published literature, technical reports and publicly available documentation, because of the limited access to their internal operational data and system environments. Furthermore, the empirical validation was conducted in the Faculty of Electrical Engineering, UiTM Pasir Gudang involving 15 academic staff which may not be representative of other faculties or institutions. Some of the benchmarking assessments also involved expert judgement and qualitative interpretation in addition to documentary evidence. While data triangulation was employed to improve reliability, some subjectivity is unavoidable in comparative benchmarking studies. Future research should include direct system testing, larger multi-institutional samples, and objective performance metrics to enhance the robustness and generalisability of the findings.

5. CONCLUSION

This study benchmarked the College of Engineering Academic Information Management System (CO-AIMS) against peer OBE systems from other institutions. Findings indicate that CO-AIMS performs particularly well in streamlined PO tracking, visualization of data, and advisory support for academics, making it a valid platform for accreditation compliance and internal CQI practices. Furthermore, the benchmarking also indicated some points of improvement. In fact, the system would improve with interoperability with LMS platforms, cross-faculty scalability of deployment, and the incorporation of AI-driven analytics for keeping pace with future global trends in academic system design.

The benchmarking findings were further supported by the feedback obtained from academic staff users about the system's usability, effectiveness and contribution towards reducing the administrative workload associated with OBE implementation. The benchmarking exercise nonetheless identified several areas for improvement. Specifically, the CO-AIMS would be improved with better interoperability with Learning Management Systems (LMS), scalability across the institution, and artificial intelligence-driven analytics for predictive decision-making and automated CQI suggestions.

Despite the restrictions of literature-based benchmarking and the faculty level respondent sample, this study provides useful insights into the comparative strengths and weaknesses of OBE-support systems and provides a practical benchmarking framework for future system development. Further research should

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include direct system evaluations in different institutions, the integration of intelligent analytics features, and the evaluation of the long-term impact on accreditation processes and educational quality enhancement.

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7. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

8. AUTHOR'S CONTRIBUTION

Norhalida Othman led the conceptualization, OBE framework integration, supervision, CQI analysis and manuscript preparation. **Ezril Hisham Mat Saat** contributed methodology development and the system validation strategy. **Nur Amalina Muhamad** assisted in data curation, system testing, and user feedback analysis. **Noor Hasliza Abdul Rahman** was responsible for visualization, dashboard design, and technical documentation. **Nor Diyana Md Sin** conducted the literature review and benchmarking analysis. **Mohd Syafiq Md Salleh** provided industry consultation and external system evaluation.

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