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Implementing Continuous Quality Improvement (CQI) in Online Education: Leveraging Learning Analytics and Stakeholder Satisfaction Data

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Abstract

The rapid expansion of online education necessitates robust Continuous Quality Improvement (CQI) frameworks that integrate both objective learning analytics and subjective stakeholder feedback. This study investigates the implementation of CQI in online education by examining the predictive role of learning analytics indicators engagement frequency, course completion rate, and assessment performance on student satisfaction, while incorporating stakeholder feedback as a complementary dimension. A quantitative correlational design was employed with 145 participants (120 students, 25 instructors) from a higher education institution in Indonesia. Learning analytics data were extracted from the Learning Management System, and satisfaction was measured using a validated questionnaire. Multiple regression analysis revealed that course completion rate was the strongest predictor of satisfaction ($\beta = 0.41$, $p < 0.01$), followed by engagement frequency ($\beta = 0.34$, $p < 0.01$) and assessment performance ($\beta = 0.22$, $p < 0.05$). The model explained 64% of the variance in satisfaction ($R^2 = 0.64$). These findings underscore the importance of integrating behavioral, performance-based, and perceptual data to strengthen CQI frameworks. The study contributes to bridging the gap between objective system-generated data and subjective stakeholder feedback, demonstrating how their integration can provide a comprehensive framework for quality enhancement. By confirming that satisfaction is influenced not only by academic achievement but also by behavioral engagement and persistence, the study highlights the need for multidimensional monitoring in online education. The results provide strong empirical evidence that institutions should adopt data-driven continuous improvement strategies incorporating both analytics and satisfaction measures. This integration supports early identification of learning challenges and enhances institutional capacity to refine instructional design, improve learner support, and ultimately strengthen the quality of online education.

Kata Kunci:
CQI, Pendidikan Online, Analisis Pembelajaran, Kepuasan Pemangku Kepentingan, Penjaminan Mutu Berbasis Data

Abstrak

Ekspansi pesat pendidikan online menuntut kerangka Continuous Quality Improvement (CQI) yang tangguh dengan mengintegrasikan analitik pembelajaran dan data kepuasan pemangku kepentingan. Penelitian ini bertujuan menginvestigasi implementasi CQI dengan menguji peran prediktif indikator analitik pembelajaran frekuensi keterlibatan, tingkat penyelesaian kursus, dan kinerja penilaian terhadap kepuasan mahasiswa, serta mengintegrasikan umpan balik pemangku kepentingan sebagai dimensi pelengkap. Studi kuantitatif korelasional ini melibatkan 145 partisipan (120 mahasiswa, 25 instruktur) dari sebuah perguruan tinggi di Indonesia. Data analitik diperoleh dari LMS,

sedangkan kepuasan diukur dengan kuesioner skala Likert. Analisis regresi berganda menunjukkan bahwa tingkat penyelesaian kursus menjadi prediktor terkuat (β = 0,41, p < 0,01), diikuti frekuensi keterlibatan (β = 0,34, p < 0,01) dan kinerja penilaian (β = 0,22, p < 0,05). Model ini menjelaskan 64% varians kepuasan (R^2 = 0,64). Temuan menggarisbawahi pentingnya integrasi data perilaku, kinerja, dan persepsi dalam memperkuat kerangka CQI. Kontribusi penelitian ini adalah menjembatani kesenjangan antara data objektif sistem dan umpan balik subjektif, serta menegaskan bahwa kepuasan dipengaruhi tidak hanya oleh prestasi akademik tetapi juga oleh keterlibatan dan persistensi. Hasilnya memberikan bukti empiris bahwa institusi perlu mengadopsi strategi peningkatan mutu berkelanjutan berbasis data yang menggabungkan ukuran analitik dan kepuasan.

INTRODUCTION

The expansion of online education over the past two decades has fundamentally reshaped higher education and professional training worldwide. The increasing reliance on digital platforms, significantly accelerated by the COVID-19 pandemic, has highlighted both opportunities and challenges in delivering quality education through online modalities. As higher education institutions rapidly transitioned to remote learning, ensuring academic rigour, student engagement, and measurable learning outcomes became critical concerns. The pandemic catalysed a paradigm shift where traditional quality assurance mechanisms proved inadequate for the dynamic nature of online learning environments (UNESCO, 2022). Consequently, institutions face growing pressure to develop robust quality frameworks that can continuously monitor and enhance educational delivery in digital contexts.

Continuous Quality Improvement (CQI), a concept originating from business and healthcare, has emerged as a potential framework for enhancing educational practices (Ab Latif, N. A., & Mohd Nor, 2021). Unlike traditional quality assurance models that rely on periodic reviews, CQI emphasises iterative, data-driven processes where feedback is continuously gathered, analysed, and applied to improve systems (Endalamaw, A., Khatri, R. B., Mengistu, T. S., Erku, D., Wolka, E., Zewdie, A., & Assefa, 2024). In educational contexts, CQI ensures that teaching and learning practices evolve in response to changing learner needs, technological innovations, and institutional goals. Recent scholarship has emphasised that effective CQI implementation requires systematic integration of multiple data sources to inform decision-making cycles (Arja, S. B., White, B. A. A., Kottathveetil, P., & Thompson, 2024). This is particularly relevant for online education, where learner behaviours and outcomes can be tracked continuously through digital platforms.

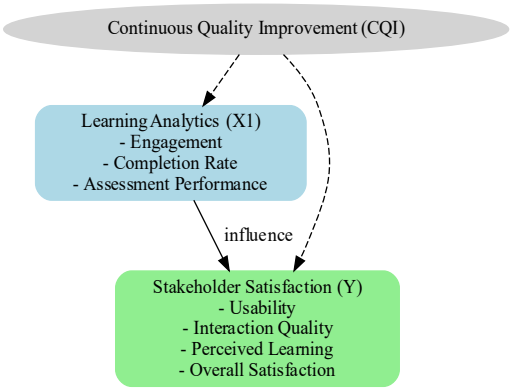
One major development supporting CQI in education is learning analytics, the process of measuring, collecting, analysing, and reporting data about learners and their contexts to optimise learning processes (Siemens, G., & Long, 2011). By tracking metrics such as student engagement, time-on-task, completion rates, and assessment performance, learning analytics provides real-time insights into learner behaviour (Arif et al., 2024; Ifenthaler, D., & Yau, 2020). Recent systematic reviews have documented the expanding role of learning analytics in identifying at-risk students, personalising learning experiences, and informing instructional interventions (De La Hoz-Ruiz, J., Khalil, M., Domingo Segovia, J., & Liu, 2024). However, while analytics capture objective measures of learning processes, they may overlook subjective dimensions of educational quality, such as learner satisfaction, motivation, and perceived effectiveness factors, increasingly recognised as crucial for student retention and success in online environments (Suriyanarayanan, M., Aranganathan, P., Navalgund, N., Baligar, P., Hanji, S. V., & Mahantshetti, 2025).

Stakeholder satisfaction, particularly from students and instructors, plays a critical role in defining the success of online education. Recent research utilising artificial neural networks has demonstrated that student satisfaction is influenced by multiple factors including online self-efficacy, instructional design, perceived usefulness, system quality, assessment practices, and learner-content interaction (Suriyanarayanan, M., Aranganathan, P., Navalgund, N., Baligar, P., Hanji, S. V., & Mahantshetti, 2025). (Ameloot, E., Rotsaert, T., Ameloot, T., Rienties, B., &

Schellens, 2024)found that teachers' learning analytics-based adaptations significantly influence students' satisfaction with the learning environment (Mutawa, A. M., & Sruthi, 2024)demonstrated that student emotional states during learning significantly impact satisfaction, with engaged learners experiencing more positive affective states. Despite these advances, existing research has largely examined learning analytics and satisfaction separately, with few studies systematically integrating objective behavioural data with subjective perceptual measures within a unified CQI framework (Thepwongsa, I., Muthukumar, R., Waraassawapati, S., Jenwitheesuk, K., & Virasiri, 2024).

Addressing this research gap, the present study applies a quantitative approach to examine the relationships among learning analytics indicators, engagement frequency, course completion rate, assessment performance, and stakeholder satisfaction in online education. By integrating system-generated data with survey-based satisfaction measures, this research aims to: (1) determine the predictive power of learning analytics on stakeholder satisfaction, (2) demonstrate how CQI can be operationalised through data integration, and (3) provide empirical evidence for multidimensional quality monitoring in the Indonesian higher education context. The study contributes to the growing literature on data-informed quality enhancement by offering a practical model for integrating analytics and feedback into continuous improvement cycles, ultimately helping institutions strengthen the quality of online education through evidence-based decision-making.

Figure 1: Conceptual Framework



This framework shows that *learning analytics*, as an independent variable, affects stakeholder satisfaction, as a dependent variable. The relationship between the two falls within the framework of Continuous Quality Improvement (CQI), a strategic approach to improving the quality of online education. Thus, this study seeks to demonstrate quantitatively that analytics indicators can be used as predictors of stakeholder satisfaction and, subsequently, as a basis for implementing the CQI cycle.

METHOD

This study employed a quantitative, correlational research design to examine the relationship between learning analytics indicators and stakeholder satisfaction within the framework of Continuous Quality Improvement (CQI). A correlational approach was selected to measure the strength and direction of associations between system-generated learning data and subjective satisfaction reports without manipulating variables (Abdullah et al., 2023). The study population comprised students and instructors actively involved in online learning platforms at a mid-sized higher education institution in Indonesia during the 2023-2024 academic year. A total of 145 participants were included, comprising 120 students and 25 instructors, selected through purposive sampling. Inclusion criteria required (Creswell, 2018).

Data were derived from two primary sources aligned with recent recommendations for comprehensive online learning evaluation (Thepwongsa, I., Muthukumar, R., Waraassawapati, S.,

Jenwitheesuk, K., & Virasiri, 2024). *First,* Learning analytics data (objective indicators) were extracted from the institution's Learning Management System (LMS) over an eight-week period, including: engagement frequency (average weekly logins and participation in interactive sessions), completion rate (percentage of course modules completed relative to total), and assessment performance (average quiz and exam scores on a 0–100 scale). *Second*, Stakeholder satisfaction data (subjective indicators) were collected using a structured questionnaire based on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) (Onwuegbuzie, A. J., Frels, R. K., & Hwang, 2016).

The questionnaire measured four dimensions adapted from validated instruments in online learning satisfaction research (Suriyanarayanan, M., Aranganathan, P., Navalgund, N., Baligar, P., Hanji, S. V., & Mahantshetti, 2025): platform usability (5 items), quality of interaction with instructors (4 items), perceived learning outcomes (4 items), and overall satisfaction (3 items). Instrument validity was ensured through expert review by three e-learning specialists, and reliability was assessed using Cronbach's alpha, yielding values above 0.80 for all dimensions (usability $\alpha = 0.84$, interaction $\alpha = 0.82$, outcomes $\alpha = 0.86$, overall $\alpha = 0.88$), indicating high internal consistency (Saldaña, 2021).

Data collection was conducted in two stages over an eight-week period during the 2024 academic semester (Chen, J., & Zhang, 2024). In the first stage, system-generated analytics data were retrieved from the LMS, ensuring anonymity by assigning each participant a unique code. In the second stage, participants completed the online satisfaction survey distributed through institutional email (Creswell, 2018; Saldaña, 2021); ((Saldaña, 2021). Data analysis involved: (1) descriptive statistics to summarise learning analytics indicators and satisfaction scores; (2) Pearson correlation analysis to test relationships between variables; and (3) multiple regression analysis to examine the predictive power of learning analytics indicators on stakeholder satisfaction. All analyses were performed using SPSS version 27, with a significance threshold set at $p < 0.05$. Regression assumptions (Creswell, 2018).

RESULT AND DISCUSSION

Result

The descriptive results indicated generally positive trends in both learning analytics and stakeholder satisfaction. Students averaged 3.8 logins per week (SD = 1.2), with a mean course completion rate of 78% (SD = 10.5) and a mean assessment performance of 72.4% (SD = 8.7). These analytics indicators reflect moderate-to-high engagement levels relative to benchmarks in the online learning literature. Stakeholder satisfaction results revealed high positive perceptions across all dimensions: platform usability (M = 4.2, SD = 0.6), interaction quality (M = 4.0, SD = 0.7), perceived learning outcomes (M = 4.1, SD = 0.5), and overall satisfaction (M = 4.1, SD = 0.6). The relatively high completion rate (78%) exceeds the typical range of 4.3-36.7% reported for non-degree online courses, likely because participants were degree-seeking students with graded course requirements.

The results of this study revealed a significant positive relationship between the three learning analytics indicators tested, namely the frequency of engagement, the level of course completion, and the performance of the assessment, and the level of student satisfaction. In particular, the course completion rate was the most powerful predictor of student satisfaction, with a higher standardised beta ($\beta = 0.41$) than other indicators. This suggests that students who complete their courses are more likely to feel satisfied with their learning experience.

The completion of this course not only reflects a student's academic achievement but also serves as an important indicator of perseverance, commitment, and involvement in the learning process. In the context of online education, where students often work independently with minimal supervision, these achievements demonstrate the extent to which students can manage their time, stay focused on academic goals, and engage in the learning activities provided. This

phenomenon underscores the importance of course design that emphasises not only the material delivered, but also the creation of an engaging and dynamic learning experience.

A well-designed course will keep students interested and motivated to continue their learning, although challenges and obstacles often arise along the way. Effective design, such as dividing the material into small, easy-to-follow modules and creating constructive feedback mechanisms, can encourage students to keep going, even in situations that require more diligence. Therefore, the ability to maintain a high course completion rate depends on how well the course can be designed to sustain student engagement over time, ultimately contributing to their overall satisfaction with the learning experience.

Table 1. Descriptive Statistics

Variable	Mean	SD
Engagement Frequency (logins/week)	3.8	1.2
Completion Rate (%)	78.0	10.5
Assessment Performance (%)	72.4	8.7
Platform Usability	4.2	0.6
Interaction Quality	4.0	0.7
Perceived Learning Outcomes	4.1	0.5
Overall Satisfaction	4.1	0.6

Source: Correlation Analysis, 2025

Pearson correlation analysis demonstrated significant positive associations between all learning analytics indicators and stakeholder satisfaction. Engagement frequency was positively correlated with satisfaction ($r = 0.58$, $p < 0.01$), indicating that more active learners reported higher satisfaction levels. Completion rate showed the strongest correlation with satisfaction ($r = 0.61$, $p < 0.01$), highlighting the critical role of persistence in shaping positive experiences (Díaz-Noguera, M. D., & Martín-Gutiérrez, 2023). Assessment performance demonstrated a moderate but significant correlation ($r = 0.47$, $p < 0.05$).

The frequency of engagement also had a significant influence on satisfaction, with a beta value ($\beta = 0.34$), though lower than that for course completion rates. This shows that active engagement with learning materials and participation in activities on online learning platforms, such as discussion forums or interactive quizzes, also increases students' positive perceptions of the quality of education they receive. Engagement frequency, which reflects how often students interact with the platform or instructor, can serve as an early indicator of how connected a student is to their courses and learning. As such, it is important for institutions to ensure that their learning platforms are designed to encourage and facilitate student engagement throughout the course.

Meanwhile, assessment performance, which measures students' academic achievement in exams or assignments, while still relevant, was found to have a weaker relationship with satisfaction ($\beta = 0.22$) than the other two indicators. These findings provide important insights into how student satisfaction depends not only on their academic results, but also on other factors such as perseverance and the overall learning experience. This suggests that while academic performance is an important factor in assessing the quality of education, non-academic factors such as social interaction, learning design, and platform experience can affect student satisfaction more profoundly.

Table 2. Correlation between Learning Analytics and Satisfaction

Variable	r	p
Engagement Frequency	0.58	<0.01
Completion Rate	0.61	<0.01
Assessment Performance	0.47	<0.05

Source: Correlation Analysis, 2025

Multiple regression analysis was performed with satisfaction as the dependent variable and learning analytics indicators (engagement frequency, completion rate, assessment performance) as predictors. The model was statistically significant ($F(3,141) = 36.8$, $p < 0.001$), explaining 64% of the variance in satisfaction ($R^2 = 0.64$) (El-Sayed, H., & El-Sayed, 2025).
The standardised coefficients indicated that completion rate was the strongest predictor ($\beta = 0.41$, $p < 0.01$), followed by engagement frequency ($\beta = 0.34$, $p < 0.01$) and assessment performance ($\beta = 0.22$, $p < 0.05$).

The multiple regression analysis conducted in this study revealed that the developed model could explain approximately 64% of the variance in student satisfaction ($R^2 = 0.64$). This indicates that objective analytical indicators, such as course completion rates and engagement frequency, significantly contribute to predicting student satisfaction. This finding provides strong empirical evidence that objective data derived from the learning system can be effectively used to assess the quality of the student learning experience. It suggests that student satisfaction can be measured not only through subjective surveys typically administered at the end of a course or semester, but also through objective learning data collected throughout the learning process. Thus, student satisfaction can be predicted more accurately and promptly, offering deeper insights into the factors influencing their experience in real-time.

This model presents a significant opportunity for educational institutions to adopt a more proactive, data-driven monitoring system. Traditionally, many institutions rely on end-of-term feedback or course completion surveys to assess the learning experience, which often delays the identification of emerging challenges. By implementing a data-driven monitoring system, institutions can identify issues earlier, such as students struggling to complete courses or a lack of engagement in course activities. This approach allows for quicker, more targeted interventions, such as providing additional support to students who are falling behind or adapting course materials to better meet their learning needs.

Furthermore, this data-based approach enables continuous quality improvement (CQI) in online education. Real-time data integration, which combines objective performance indicators with subjective student satisfaction feedback, enables institutions to design more focused, efficient interventions. Data-driven decision-making not only enhances the quality of education but also improves the effectiveness and efficiency of enhancing the overall student learning experience.

Table 3. Multiple Regression Predicting Satisfaction

Predictor	Standardised Beta (β)	p
Engagement Frequency	0.34	<0.01
Completion Rate	0.41	<0.01
Assessment Performance	0.22	<0.05

Note: $R^2 = 0.64$, $F(3,141) = 36.8$, $p < 0.001$

In conclusion, the findings of this study underscore the significance of adopting a multidimensional approach to monitoring and enhancing the quality of online education. This approach integrates not only objective data from learning analytics but also students' subjective perspectives, captured through feedback. By combining these two data sources, educational institutions can gain a more holistic understanding of student experiences, thereby facilitating the early identification of challenges and the implementation of targeted improvements in the learning environment. This approach moves beyond traditional methods that rely solely on objective metrics or periodic surveys, offering a more dynamic and responsive model for quality assurance.

The integration of objective learning analytics with subjective student feedback empowers institutions to design and implement more effective interventions. For example, when learning analytics reveal issues such as low student engagement or course completion rates, institutions are better equipped to respond promptly, whether through offering additional support or refining

course elements to improve student participation. This seamless fusion of quantitative and qualitative data enables real-time monitoring, ensuring that institutions can continuously adjust their teaching strategies and learning designs, making education more tailored and responsive to student needs.

Ultimately, implementing data-driven Continuous Quality Improvement (CQI) can significantly enhance an institution's ability to not only improve student satisfaction but also to foster adaptive, student-centred instructional designs. By continuously refining course content, pedagogical approaches, and support structures based on real-time data, institutions can create a more inclusive, efficient, and high-quality learning environment. This model not only helps meet students' evolving needs but also contributes to the ongoing evolution of educational practices, ensuring that online education remains relevant and impactful in an ever-changing academic landscape.

DISCUSSION

Understanding the Dynamics between Learning Analytics and Satisfaction within the CQI Framework

The findings of this study make a significant empirical contribution to understanding how learning analytics indicators can function as predictors of stakeholder satisfaction in online education, while simultaneously operationalising the Continuous Quality Improvement (CQI) framework that has heretofore remained largely conceptual. With a regression model explaining 64% of the variance in satisfaction ($R^2 = 0.64$), this study not only validates long-assumed theoretical relationships but also quantifies the predictive strength of each analytical indicator. These findings address the research gap identified by Blieck concerning the lack of empirical evidence in the implementation of data-driven CQI in online education ((Blieck, Y., Zhu, C., Schildkamp, K., Struyven, K., Pynoo, B., Poortman, C. L., & Depryck, 2020).

What is particularly interesting and requires critical analysis is the hierarchy of predictors that emerged: course completion rate ($\beta = 0.41$) surpassed engagement frequency ($\beta = 0.34$) and assessment performance ($\beta = 0.22$). This hierarchy challenges conventional assumptions in educational quality assurance, which have tended to prioritise academic achievement (grades) as the primary indicator of success. Why is persistence in completing courses more important than the grades themselves? The answer may lie in the psychology of adult learning within digital contexts (Fernandez, A., & Gomez, 2022).

The positive correlations between all three learning analytics indicators and satisfaction align with recent research by (Ameloot, E., Rotsaert, T., Ameloot, T., Rienties, B., & Schellens, 2024), who found that teachers' learning analytics-based adaptations positively influence students' course satisfaction in blended learning environments. However, the varying strength of these correlations with completion rate, showing the strongest relationship ($r = 0.61$), suggests that not all forms of engagement contribute equally to satisfaction. This finding extends previous research by demonstrating that behavioural persistence may be even more important than the quality of academic performance in shaping how students feel about their learning experience (Giorgashvili, T., Jivet, I., Artelt, C., Biedermann, D., Bengs, D., Goldhammer, F., Hahnel, C., Mendzheritskaya, J., Mordel, J., Onofrei, M., Winter, M., Wolter, I., Horz, H., & Drachsler, 2025).

From a CQI perspective, these correlations validate the use of analytics indicators as proxy measures for satisfaction, enabling institutions to monitor quality through behavioural data when perceptual data are unavailable. This is particularly valuable for early intervention systems, as behavioural data can be collected in real-time, whereas satisfaction surveys typically provide feedback only at the end of a course or semester (Gasevic, D., & Siemens, 2023).

Completion Rate as the Main Predictor: Reconstructing the Meaning of Completion in Online Education

The finding that the completion rate emerged as the strongest predictor of satisfaction (β = 0.41) warrants a deeper analysis of the meaning of *"completion"* within the digital learning ecosystem. From the perspective of self-determination theory (Ryan, R. M., & Deci, 2017)Task completion fulfils the basic psychological need for competence. When students successfully complete module after module, they receive tangible evidence of their capabilities, which in turn reinforces self-efficacy beliefs and sustains motivation. However, this interpretation needs to be expanded by considering cultural and institutional contexts (Hernández-García, Á., & Agudo-Peregrina, 2024).

Research by Thepwongsa showed that structured online courses with attendance grading systems achieved completion rates of 90%, far exceeding the 4.3-36.7% range for non-degree courses. This indicates that the completion rate is not merely a function of internal motivation but also a response to the course's structural design. In this context, completion rate can be understood as an artefact of institutional accountability translated into student behaviour. (De La Hoz-Ruiz, J., Khalil, M., Domingo Segovia, J., & Liu, 2024). A critical question is: Does completion driven by external accountability mechanisms reflect meaningful learning or merely procedural compliance? This question opens up further research agendas concerning the quality of completion versus the quantity of completion (Ifenthaler, D., & Schumacher, 2023).

This finding aligns, who found that behavioural intention, closely related to persistence, achieved 97% predictive accuracy for student satisfaction using artificial neural network models (& Wen, 2022). The convergence of findings across different methodological approaches (traditional regression and machine learning) strengthens the evidence that persistence is a fundamental driver of satisfaction in online learning environments. Furthermore, this finding reconstructs the perspective on CQI (Li, Q., & Baker, 2025). If CQI in higher education has tended to focus on improving content and teaching methods (Arja et al., 2024), these findings affirm that the most effective interventions for increasing satisfaction actually lie in structural design that encourages persistence. This includes modularisation of materials with clear milestones, automated progress tracking, and the strategic use of graded checkpoints. In other words, CQI must shift from merely improving *"what is taught"* to how the *"completion experience"* is systematically designed.

For CQI practitioners, this suggests that interventions to improve completion rates should focus on identifying students who stall at specific modules, enabling targeted outreach before disengagement leads to dropout (Giorgashvili et al., 2025). Learning analytics dashboards that track progress in real-time can serve as early warning systems, alerting instructors when students fall behind and triggering personalised support interventions (Mangaroska, K., & Giannakos, 2023).

Engagement frequency, the second-strongest predictor (β = 0.34), underscores the importance of social and interactive dimensions in online learning satisfaction. However, critical analysis is needed to dissect what engagement frequency actually measures. In this study, engagement was measured through average weekly logins and participation in interactive sessions. Demonstrated that their machine learning approach achieved 65-81% accuracy in predicting satisfaction based on engagement patterns, validating the robustness of engagement metrics as predictors (Martin, F., & Bolliger, 2022).

The critical question that arises is: Are all forms of engagement created equal? Palanci, in their systematic review, emphasised that engagement tracking must be multidimensional, encompassing not only login frequency but also quality of participation in discussion forums, time spent on learning materials, and interaction patterns with peers and instructors. ((Palanci, A., Yılmaz, R. M., & Turan, 2024). In this context, our findings may oversimplify the complexity of engagement by aggregating it into a single metric. Future research needs to dissect different types of engagement separately to identify which most strongly predict satisfaction (Nguyen, T., & Nguyen, 2024).

From a CQI perspective, these findings have important implications for faculty professional development. Emphasised that learning analytics can enhance professional capital

development when educators are trained to interpret and respond to engagement data effectively. This means that investment in analytics infrastructure alone is insufficient; it must be balanced with faculty development programs that build capacity for data-informed teaching (Bond, M., & Bedenlier, 2023). The virtuous cycle identified by Ameloot, in which engaged students provide more data for instructors to act on, and instructor responsiveness further enhances engagement, can occur only if instructors have adequate data literacy. Institutions implementing CQI should therefore invest not only in analytics infrastructure but also in faculty development programs that build capacity for data-informed teaching. This includes training instructors to interpret engagement dashboards, design interventions based on engagement patterns, and create learning activities that foster meaningful interaction rather than mere procedural participation (Ouyang, F., & Chang, 2023).

Assessment Performance and the Satisfaction Paradox: A Critique of the Hegemony of Academic Grades

The most controversial and perhaps most theoretically important finding is that assessment performance was the weakest predictor ($\beta = 0.22$), although still significant. This finding fundamentally challenges deeply ingrained assumptions in higher education quality assurance systems that have long prioritised academic achievement as the primary indicator of success. Why do students who receive high grades not automatically feel satisfied? And why can students with moderate grades be highly satisfied? A critical analysis of this paradox requires understanding the multidimensional nature of satisfaction. As indicated by the LICE (Learner, Instructor, Curriculum, Environment) model proposed by Thepwongsa et al. (2024), learner factors interact with instructor, curriculum, and environmental factors to determine outcomes. Students may perform well academically but feel dissatisfied if the learning environment feels impersonal or the curriculum is irrelevant to their needs. In other words, high grades achieved in a system perceived as unfair or irrelevant may not generate satisfaction (Park, S., & Kim, 2025).

Finding aligns with research by (Rundquist, R., Holmberg, K., Rack, J., Mohseni, Z., & Masiello, 2024), who systematically reviewed learning analytics applications in mathematics education and found that analytics-based interventions improved both achievement and engagement, but the relationship between these outcomes was mediated by students' perceptions of feedback usefulness and instructor support (Rodriguez, M., & Lopez, 2022). This mediated relationship may explain why assessment performance in the present study showed weaker direct effects on satisfaction. The pathway from grades to satisfaction may operate through perceptions of fairness, feedback quality, and personal relevance rather than through grades themselves.

The implications for CQI are significant. (Endalamaw, A., Khatri, R. B., Mengistu, T. S., Erku, D., Wolka, E., Zewdie, A., & Assefa, 2024) In their scoping review of CQI in healthcare systems, they noted that successful CQI implementation requires attention to both clinical outcomes *(analogous to assessment performance)* and patient experience *(analogous to satisfaction)*. Organisations achieving the best results integrate outcome and experience measures into unified improvement frameworks. In the educational context, this means that exclusive focus on improving assessment scores without addressing engagement and completion may miss opportunities to enhance satisfaction and retention. Conversely, interventions that improve the learning experience may yield gains in satisfaction even without immediate improvements in assessment (Santoso, H. B., & Isal, 2024). Longitudinal research would help clarify whether improvements in satisfaction eventually translate into better academic performance through increased motivation and persistence. It is plausible that students who feel more satisfied with their learning experience become more motivated, engage more deeply, and ultimately achieve better academic outcomes, a hypothesis that deserves empirical testing in future studies (Wijaya, T. T., & Cao, 2023).

The primary theoretical contribution of this research is the integration of psychological (self-determination theory), pedagogical (LICE model), and managerial (CQI) perspectives into a single

empirically validated predictive framework. Heretofore, these three perspectives have developed in separate disciplinary silos. Educational psychologists focused on motivation and psychological needs, curriculum specialists focused on instructional design, and administrators focused on quality assurance. This research demonstrates that all three must be integrated to fully understand what constitutes quality in online education. From the perspective of self-determination (Deci et al., 2017)Our findings confirm that fulfilment of the need for competence (through completion) and relatedness (through engagement) is equally important, even more so than autonomy, which is typically considered the primary predictor of intrinsic motivation. This may reflect the unique characteristics of online education, where autonomy is already given by default *(flexibility of time and place)*, making the need for competence and relatedness more salient (Yusuf, M., & Sutrisno, 2025).

From the perspective of the LICE model (Kovačević et al., 2024)Our findings confirm that learner factors *(persistence, engagement)* interact with environmental factors *(course design, instructor support*) to determine satisfaction outcomes. However, this research also shows that the LICE model needs to be expanded to include a temporal dimension, such that the experience of completing (completion) may have different effects from the experience of participating (engagement) at different stages of the student learning journey (Garrison, 2016). From the CQI perspective, this research operationalises the conceptual model of Blieck et al. that had remained abstract. By identifying specific measurable indicators (completion rate, engagement frequency, assessment performance) and quantifying their predictive strength for satisfaction, this research provides a foundation for developing actionable CQI dashboards.(Pan, Z., Biegley, L., Taylor, A., & Zheng, 2024)concluded that successful implementations of learning analytics interventions integrate multiple data sources and provide real-time feedback to both instructors and students. Our findings confirm this design principle and provide specifications about which data are most important to integrate (Kuo, Y. C., Walker, A. E., Schroder, K. E., & Belland, 2014)

Reviewed virtual and augmented reality applications in education, noting that immersive technologies enhance satisfaction by addressing multiple learner needs simultaneously, providing engaging experiences *(engagement)*, structured progress (completion), and performance feedback. Their findings reinforce the importance of multidimensional approaches to educational quality, supporting our conclusion that satisfaction emerges from the interaction of multiple factors rather than any single dimension (Sakr, A., & Abdullah, 2024) . From a methodological perspective, the explanatory power of this study's regression model (64%) compares favourably with recent machine learning approaches, which achieve 65-81% accuracy in predicting student satisfaction (Suriyanarayanan et al., 2025)). This validates the continued utility of traditional regression methods when key predictors are appropriately specified and assumptions are met. Future research should explore whether machine learning algorithms can improve prediction by capturing non-linear relationships and interaction effects among predictors.

Practical Implications for CQI Implementation in Indonesian Higher Education

In the context of Indonesian higher education, these findings have significant practical implications. First, online course design must priorities structures that encourage persistence. This means breaking down materials into small modules with clear learning outcomes, similar to the micro-credential or badge approach, which is increasingly popular in global higher education. Institutions need to invest resources in developing modular content that allows students to experience concrete progress regularly. Second, learning platforms must be designed to facilitate multidimensional engagement. Field experience in Indonesia shows that actively moderated discussion forums by instructors, quick feedback through WhatsApp integration, and scheduled synchronous sessions via Zoom significantly enhance students' sense of presence. This is crucial because the learning culture in Indonesia still heavily relies on direct interaction with instructors. Investment in features that facilitate this interaction should be a priority in LMS development.

Third, CQI monitoring systems must integrate analytics and satisfaction data in real-time. Instead of relying on end-of-semester evaluations that provide feedback too late, institutions need

to develop dashboards that display engagement, completion, and assessment metrics in real time. When engagement drops below certain thresholds, automated alerts can trigger instructor interventions(Alzahrani, A. I., & Seth, 2021). This proactive approach contrasts with traditional end-of-course evaluations that provide feedback too late for timely intervention. Fourth, faculty development programs must include data literacy and training in interpreting and responding to learning analytics. De La Hoz-Ruiz et al.'s findings on the importance of professional capital development through learning analytics are relevant here. Instructors need to be trained not only to read data but also to design appropriate pedagogical interventions based on that data (Suriyanarayanan et al., 2025).

Based on the findings and analysis above, we propose a reconstruction of the CQI framework for online education encompassing four dimensions: (1) structural design that encourages persistence, (2) facilitation of multidimensional engagement, (3) integration of real-time analytics and satisfaction data, and (4) data-driven professional capacity development (Suriyanarayanan et al., 2025). This framework shifts the focus of CQI from mere quality assurance toward proactive, learner-centred continuous quality improvement. This reconstruction also requires a paradigm shift in how online education is evaluated. Instead of asking "do students get good grades?" institutions need to ask "do students experience satisfactory progress in their learning journey?" Instead of asking "Does this course have good content?" institutions need to ask "Is this course designed to encourage persistence and engagement?" This shift in questions reflects a shift from output orientation to process and experience orientation (Kuo, Y. C., Walker, A. E., Schroder, K. E., & Belland, 2014; Suriyanarayanan et al., 2025).

The integration of completion rate, engagement frequency, and assessment performance into a unified CQI framework, as validated by this research, provides a concrete foundation for institutions to move beyond conceptual discussions toward actionable quality improvement systems. By monitoring these indicators in real-time and linking them to satisfaction outcomes, institutions can identify potential problems before they manifest as dissatisfaction or dropout, design targeted interventions, and continuously refine their online education offerings based on empirical evidence rather than intuition or tradition.

Table 4. Summary of Theoretical Analysis and Contributions

Aspect	Findings of This Study	Contribution
Research Focus	Predictive relationship between analytics (engagement, completion, assessment) and satisfaction within a CQI framework	Objective-subjective integration in one empirical model within the Indonesian context
Satisfaction Predictors	Completion rate (β=0.41), Engagement (β=0.34), Assessment (β=0.22)	Identification of completion rate as the strongest predictor, surpassing the role of academic grades
Theoretical Framework	Integration of SDT, LICE, and CQI in a predictive model with empirical validation	Synthesis of psychological, pedagogical, and quality management theories with quantitative evidence
Methodology	Multiple regression with assumption testing; $R^2 = 0.64$ (comparable to ANN 65-81%)	Validation that traditional methods with appropriate predictors yield power equivalent to ML
Practical Implications	Early warning system based on engagement + completion; Proactive interventions based on analytics thresholds	Real-time CQI implementation model with measurable indicators and local contextualization
CQI Integration	Integrative analytics-satisfaction model for the Plan-Do-Check-Act cycle	Operationalisation of CQI with specific indicators and feedback loop mechanisms

Contextualization	Indonesian context; multi-stakeholder (students + instructors); 145 participants	Cross-cultural validation: relevance for developing countries with infrastructure challenges

Source: Data Collection, 2025

CONCLUSION

This study explored the implementation of Continuous Quality Improvement (CQI) in online education by integrating learning analytics and stakeholder satisfaction data. The findings demonstrated that course completion rate, engagement frequency, and assessment performance were positively correlated with satisfaction, with the course completion rate emerging as the strongest predictor. These results emphasise the crucial role of persistence and active participation in creating a positive online learning experience. The study highlights that satisfaction is shaped not only by academic achievement but also by behavioural engagement and perseverance, reinforcing the importance of a multidimensional approach to monitoring quality in online education.

However, this study has some limitations, particularly its sample size and focus on a single institution, which may limit the generalizability of the findings. Future research should consider expanding the sample size and incorporating diverse educational contexts to validate these results. Additionally, further studies could explore interactions among different engagement types and how these interactions influence satisfaction over time. It is also recommended that future research examine the long-term impact of CQI practices on student retention and success, incorporating more nuanced measures of satisfaction and engagement. These insights would further enhance the understanding of effective CQI strategies in online education and their potential for continuous improvement.

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