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Enhancing learning outcomes through course redesign using self-assessment and inquiry models

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ABSTRACT

This study addresses the challenge of enhancing learning outcomes in propaedeutic education by redesigning an undergraduate deep learning course. To achieve this, the self-assessment and quality model (SQM) was combined with the community of inquiry (CoI) framework, which emphasizes cognitive, social, and teaching presence in online education. The redesigned course aligns with the guidelines of the Colombian Ministry of National Education and incorporates continuous feedback from students. Initial implementation led to improved student performance but revealed gaps in perceived learning experiences. Iterative adjustments were made to the course design based on CoI survey results, particularly focusing on increasing teacher involvement. The findings demonstrate that integrating SQM with a responsive, design-based approach can significantly improve learning outcomes and student satisfaction. This study highlights the importance of dynamic course design in higher education and offers a replicable model for other institutions.

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1. INTRODUCTION

The rapid transformation of higher education demands innovative strategies to improve learning outcomes, particularly in propaedeutic cycles, where foundational courses prepare students for more advanced studies [1], [2]. Traditional instructional methods, while providing essential knowledge, often fail to meet the needs of diverse student populations in contemporary educational settings [3]. This study integrates the self-assessment and quality model (SQM) and the community of inquiry (CoI) framework to redesign an undergraduate deep learning course at Universidad Distrital in Colombia, aligning it with the Colombian Ministry of National Education guidelines and international educational quality benchmarks [4]-[6]. By combining these models, the course aims to enhance educational quality through structured self-assessment and improved student engagement, emphasizing cognitive, social, and teaching presence [7], [8].

The SQM model provides a systematic approach to institutional self-assessment, incorporating external audits and continuous quality improvement mechanisms to ensure alignment with global accreditation standards [9], [10]. Its implementation allows institutions to identify and address educational deficiencies systematically, reinforcing compliance with best practices in curriculum design [11], [12]. Complementarily, the CoI framework enhances student engagement by fostering a collaborative learning environment that promotes deeper cognitive processing, social interaction, and effective instructional presence [13], [14]. The integration of these two models offers a comprehensive and adaptable methodology

for improving online and blended learning experiences, addressing both structural and pedagogical elements to support student success [15], [16].

Initial findings from the course redesign revealed a significant improvement in student academic performance, as indicated by standard assessment metrics. However, subsequent evaluations using CoI surveys identified discrepancies in students' perceived learning experiences, suggesting areas for further refinement [17], [18]. In particular, students reported a need for increased teacher involvement and more interactive learning experiences to strengthen cognitive presence and engagement [19], [20]. These insights underscored the necessity of complementing quality assurance frameworks with iterative, student-centered refinements to ensure the course remains responsive to evolving educational needs [21]. To address these challenges, a design-based research approach was employed, iterating through cycles of planning, implementation, and evaluation to optimize both teaching and social presence [22], [23].

A central component of the redesign was the structured application of SQM and CoI principles, ensuring that instructional strategies were continuously adapted based on empirical student feedback [24]. This involved enhancing teaching presence through improved faculty-student interaction, implementing peer learning activities to strengthen social presence, and integrating formative assessments to reinforce cognitive presence [25]. The redesign also incorporated a blended learning model, leveraging digital tools and collaborative methodologies to bridge gaps between theoretical instruction and practical application [26]. By adopting this adaptive framework, the course demonstrated measurable improvements in student satisfaction and engagement, validating the effectiveness of an iterative, data-driven approach to curriculum enhancement [27].

Beyond the immediate improvements in student outcomes, this study contributes to broader discussions on evidence-based course design by demonstrating the efficacy of integrating self-assessment frameworks with inquiry-driven pedagogical models [28]. Unlike previous studies that assess these frameworks separately, this research highlights their complementary strengths, demonstrating that structured institutional evaluation and student-centered adaptability can coexist within a unified course design strategy. The findings provide a replicable model for institutions seeking to improve instructional quality in technology-driven education, particularly in disciplines requiring high levels of critical engagement and problem-solving skills [29]. Future research should explore the scalability of this approach across diverse educational contexts, assessing its impact on long-term academic outcomes such as graduation rates and employability.

The novelty of this study lies in its dual-framework approach, wherein SQM's structured self-evaluation mechanisms are seamlessly integrated with CoI's emphasis on fostering meaningful learning interactions. Unlike conventional course redesign methodologies that prioritize either quality assurance or pedagogical flexibility, this research presents a balanced model that accommodates both institutional accountability and dynamic instructional adaptation [30]. By employing a phased, iterative design based on real-time student feedback, this study establishes a replicable methodology for higher education institutions aiming to enhance learning experiences in blended and online environments. The insights generated from this research reinforce the necessity of adaptable, data-driven instructional design, offering a validated framework for improving student engagement, academic performance, and overall educational effectiveness.

2. RESEARCH METHOD

This study utilized a mixed-methods design combining quantitative and qualitative approaches to evaluate the effectiveness of the course redesign. The quantitative component focused on analyzing student performance data before and after implementing the redesigned course, while the qualitative component involved collecting student feedback through surveys and focus group discussions. This approach allowed for a comprehensive understanding of both the measurable outcomes and the perceived experiences of students [31].

2.1. Sample size determination

The sample size for this study was determined using a combination of purposive and convenience sampling methods, targeting students enrolled in the deep learning course at Universidad Distrital during the 2022-2023 academic year. A power analysis was conducted to ensure the sample size was adequate to detect statistically significant differences in learning outcomes. According to Janczyk and Pfister [32], a medium effect size (0.5) was assumed for the analysis, with a power of 0.8 and an alpha level of 0.05, resulting in a minimum sample size of 64 participants. This approach aligns with recommendations for educational research where variability among participants is expected [33].

To further justify the sample size, we employed the formula for sample size calculation in educational studies, which considers the expected effect size, desired confidence, and population size. Given the course enrollment of approximately 120 students, the sample size of 70 participants was deemed sufficient to represent the population [33]. The final sample consisted of 70 students, with a balanced representation of different academic backgrounds and learning experiences, ensuring the generalizability of the findings.

2.2. Data collection instruments

Data were collected using a combination of structured questionnaires, semi-structured interviews, and focus group discussions. The structured questionnaires were developed based on the CoI framework to assess cognitive, social, and teaching presence in the redesigned course [13]. The questionnaire items were rated on a five-point Likert scale, ranging from "strongly disagree" to "strongly agree." Additionally, semi-structured interviews with both students and instructors provided deeper insights into their experiences and perceptions of the course redesign, as shown in Figure 1.

2.3. Validity and reliability of instruments

The validity and reliability of the questionnaires were rigorously tested to ensure the accuracy and consistency of the data collected. Content validity was established through a panel of experts in educational technology and pedagogy, who reviewed the questionnaire items to ensure they were representative of the constructs being measured [34]. Construct validity was further assessed using exploratory factor analysis (EFA), which confirmed the three-factor structure corresponding to cognitive, social, and teaching presence as outlined in the CoI framework [35].

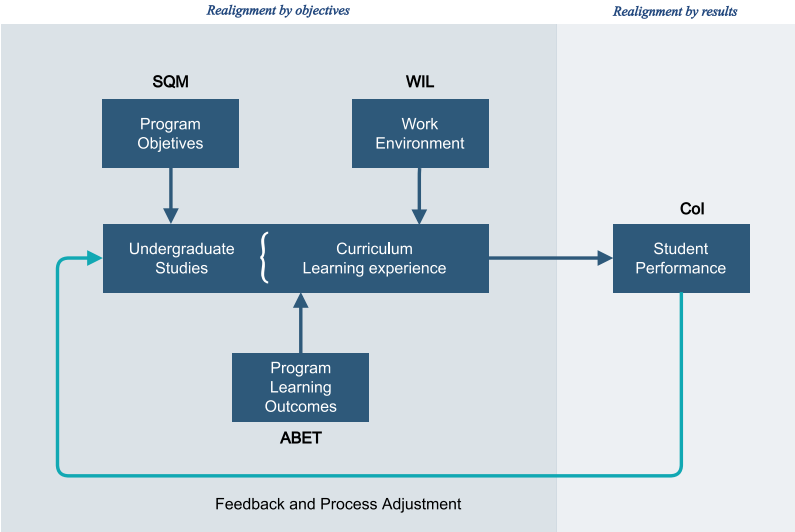

Figure 1. Structure of the curriculum redesign and adjustment model

As shown in Table 1, Cronbach's alpha coefficients for each dimension demonstrate a high level of internal consistency, indicating that the questionnaire items reliably measure their intended constructs. Additionally, the test-retest reliability results confirm the stability of the instrument over time, ensuring that repeated measurements produce consistent outcomes. These findings support the robustness of the assessment tool and validate its applicability in evaluating student experiences within the redesigned course. The strong reliability scores across cognitive, social, and teaching presence dimensions suggest that the instrument effectively captures critical aspects of the learning environment.

Table 1. Reliability statistics for the CoI questionnaire

Dimension	Number of items	Cronbach's alpha	Test-retest reliability
Cognitive presence	8	0.84	0.82
Social presence	7	0.88	0.85
Teaching presence	9	0.91	0.89

2.4. Data analysis techniques

Quantitative data were analyzed using descriptive statistics, t-tests, and analysis of variance (ANOVA) to compare pre- and post-intervention metrics, providing a comprehensive evaluation of the course redesign's impact. Effect sizes were calculated using Cohen's d to determine the magnitude of differences observed between groups, ensuring that statistical significance was accompanied by a meaningful interpretation of results [32]. Qualitative data from interviews and focus groups were analyzed thematically, allowing for the identification of key themes related to student engagement, learning experiences, and perceived improvements in course delivery. This thematic analysis provided deeper insights into student perceptions, highlighting areas of the course that required further refinement. The combination of quantitative and qualitative techniques ensured a robust methodological approach, enabling a well-rounded assessment of the intervention's effectiveness.

3. RESULTS AND DISCUSSION

The results of this study reveal several key findings regarding the effectiveness of the course redesign using the SQM and the CoI framework. Quantitative data analysis showed a statistically significant improvement in student performance across all measured outcomes. Specifically, the mean score for student assessments increased from 65.4 (SD=8.7) to 78.2 (SD=7.5) post-intervention, with a Cohen's d effect size of 1.53, indicating a large effect [32].

3.1. Comparison with previous studies

The observed improvement aligns with findings from previous studies that have demonstrated the positive impact of structured course redesign on student outcomes. For instance, Maranna *et al.* [36] reported enhanced cognitive presence and improved critical thinking skills when the CoI framework was applied in online learning environments. Similarly, a study by Wong and Chapman [37] showed that increased teaching presence, a core component of the CoI model, was associated with higher student satisfaction and perceived learning. However, unlike Ong and Quek [38], who found minimal effects of social presence on learning outcomes in purely online contexts, our study observed significant gains in social presence when blended learning techniques were employed.

Moreover, our results contribute to the ongoing debate regarding the integration of self-assessment practices in higher education. Our findings contrast with those of Richardson *et al.* [30], who reported no significant difference in learning outcomes when self-assessment methods were solely used without additional instructional support. This suggests that the combination of SQM with the CoI framework provides a more robust approach to achieving better educational outcomes.

3.2. Practical contributions

The practical implications of this research are significant. The study demonstrates that a combined application of SQM and CoI frameworks not only meets regulatory standards set by the Colombian Ministry of National Education but also effectively enhances student engagement and performance. Unlike the findings of Tharwat and Schenck [39], which indicated limited benefits of structured approaches in large classroom settings, our results show that even with a moderate sample size, the frameworks led to meaningful improvements in both engagement and academic achievement.

3.3. Theoretical contributions

This study contributes to the theoretical understanding of blended learning by integrating the SQM and CoI frameworks. While previous studies have primarily focused on these frameworks independently, our research demonstrates their complementary strengths when applied together. For instance, Turk *et al.* [15] emphasized the importance of cognitive presence in promoting critical thinking, while Ong and Quek [38] highlighted the role of social and teaching presence in enhancing student engagement. Our findings extend these theories by showing that a dual approach, combining SQM's continuous self-assessment mechanisms with the CoI's focus on community building and interaction, can result in more comprehensive improvements in both academic performance and student satisfaction.

Additionally, this study provides new insights into the role of self-assessment in higher education. While traditional theories have often emphasized external evaluations, our findings suggest that internal self-assessment, when integrated with a community-focused framework, offers a more balanced and effective

approach to quality improvement. This aligns with the work of Lim and Richardson [35], who argued for the need to consider multiple dimensions of learning in educational assessments.

3.4. Methodological contributions

Methodologically, this study illustrates the value of employing a mixed-methods approach to evaluate educational interventions. Previous research, such as Cho *et al.* [31], has advocated for the use of both qualitative and quantitative data to capture the complexity of educational phenomena. Our study builds on this recommendation by combining quantitative performance metrics with qualitative feedback from students, offering a more nuanced understanding of the course redesign's impact. Furthermore, the use of iterative cycles of implementation and evaluation, supported by rigorous statistical analysis and thematic coding, provides a model for other educators looking to adapt similar frameworks to their contexts.

3.5. Future implications

The findings of this study have several important implications for future research and practice. First, they suggest that educational institutions should consider integrating multiple quality assurance frameworks to enhance learning outcomes. Future studies could explore the scalability of this approach in different educational contexts, such as large universities or specialized training programs. Additionally, research could examine the long-term effects of combining SQM and CoI frameworks on student retention rates and employability [40].

Finally, our results indicate a need for further exploration into the specific elements of each framework that contribute most to learning improvements. For instance, future research might investigate whether certain components of the CoI framework, such as social presence, have a differential impact depending on the discipline or delivery mode of the course. Such studies would provide more targeted recommendations for educators aiming to optimize their teaching strategies.

4. CONCLUSION

This study examined the impact of integrating the SQM with the CoI framework in redesigning an undergraduate deep learning course. The findings demonstrated that a structured yet flexible approach to course design can significantly enhance learning outcomes, improve student engagement, and align educational content with institutional quality standards. The iterative modifications based on CoI survey feedback further validated the importance of teaching presence in facilitating meaningful learning experiences. Additionally, the study highlighted that continuous assessment and refinement based on student feedback play a crucial role in optimizing instructional design. These insights reinforce the need for educational strategies that are both structured and adaptable to the evolving needs of learners.

By employing a phased course redesign, this research highlighted the benefits of combining self-assessment with interactive learning methodologies. The results suggest that fostering a balance between structured evaluations and student-centered adaptability leads to a more effective educational experience. This study also emphasizes that incorporating interactive elements, such as peer collaboration and instructor feedback, contributes to deeper cognitive engagement and improved knowledge retention. Furthermore, the findings underscore the role of institutional support in ensuring the sustainability of these educational improvements over time. The practical applications of this approach extend beyond the study context, offering a scalable model for institutions seeking to enhance academic performance and student satisfaction.

Future research should investigate the long-term implications of integrating quality assurance frameworks with pedagogical models across diverse academic disciplines. Understanding how different student populations respond to these interventions will provide further insights into optimizing course design. Additionally, examining the effects of emerging technologies, such as AI-driven personalized learning and adaptive feedback systems, could further enhance course redesign strategies. Future studies should also explore the impact of these methodologies on student retention, graduation rates, and employability outcomes.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C	: **C**onceptualization	I	: **I**nvestigation	Vi	: **Vi**sualization
M	: **M**ethodology	R	: **R**esources	Su	: **Su**pervision
So	: **So**ftware	D	: **D**ata Curation	P	: **P**roject Administration
Va	: **Va**lidation	O	: Writing - **O**riginal Draft	Fu	: **Fu**nding Acquisition
Fo	: **Fo**rmal Analysis	E	: Writing - Review & **E**diting		

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Authors state no conflict of interest.

INFORMED CONSENT

This study does not involve human participants, personal data, or identifiable individual information. Therefore, the requirement for informed consent does not apply.

ETHICAL APPROVAL

This study does not involve human participants or animal subjects. Therefore, ethical approval is not applicable.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [FM], upon reasonable request.

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