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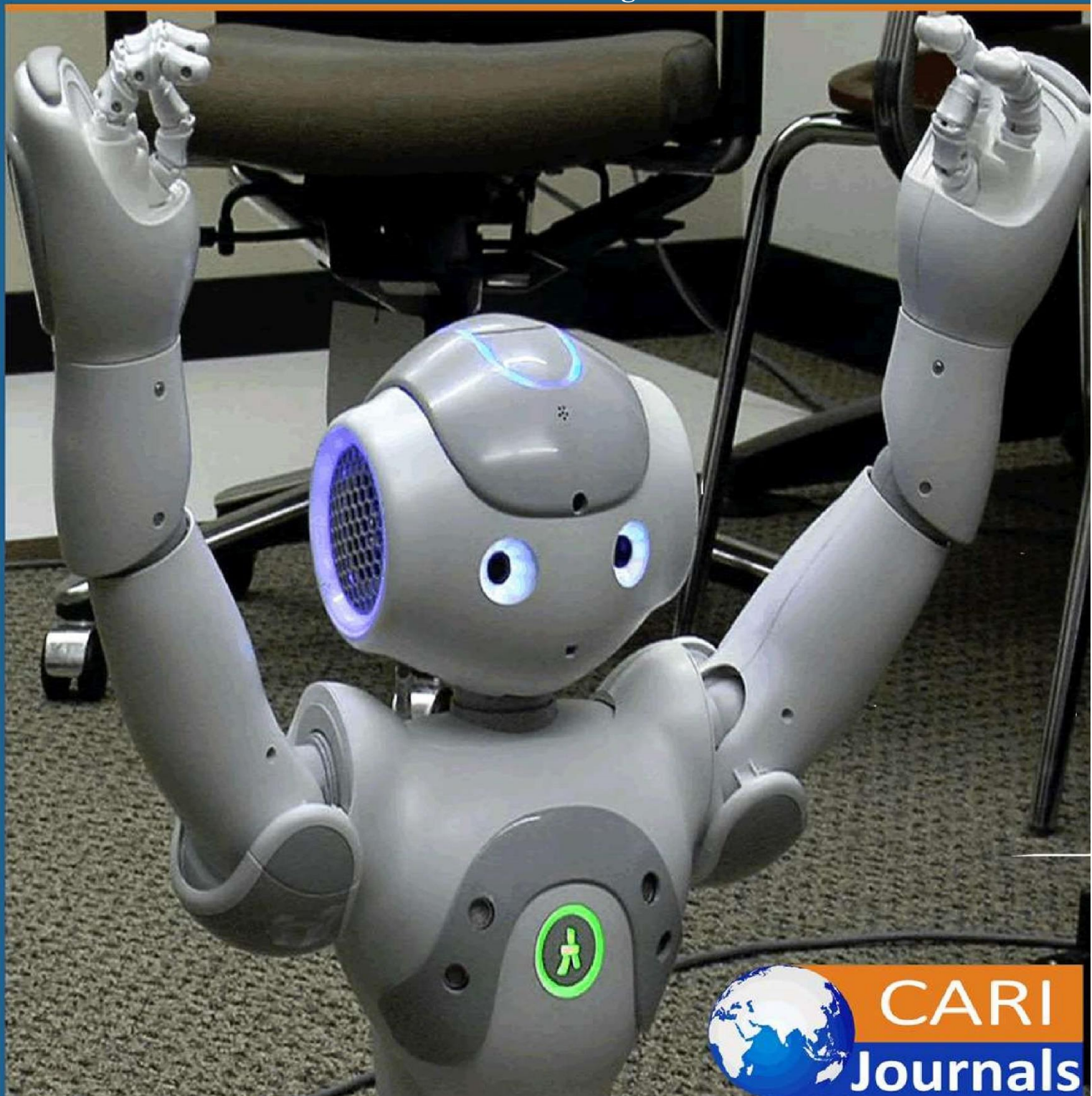

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Implementation of a Peer Assessment Framework for Online Group Based Assessment in Higher Institutions of Learning

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Abstract

Purpose: The increasing use of online collaborative learning in higher education presents both opportunities and challenges, particularly in the implementation of peer assessment (PA) systems. This study aims to develop a comprehensive framework for implementing peer assessment (PA) in online collaborative learning environments within higher education. It seeks to enhance student engagement, foster collaborative skills, and improve learning outcomes by addressing the challenges associated with PA implementation.

Methodology: In this study, we employed the DeLone and McLean Information Systems Success Model (DeLone & McLean, 2003) as a theoretical framework to guide the development and evaluation of the proposed peer assessment (PA) framework to support group-based assessment in eLearning environments.

Findings: Communication channels played a crucial role, with satisfaction scores rising from 2.75 (low communication) to 4.25 (strong communication) when effective channels were in place. Instructor feedback emerged as an important predictor, with students rating their experience higher when feedback was provided.

Unique Contribution to Theory, Policy and Practice: Integrating monitoring tools and enhancing system customization will be crucial for improving the effectiveness of peer assessment in online learning. As such, educational institutions must invest in both technology and professional development to ensure the successful implementation of collaborative learning tools.

Keywords: *Peer Assessment, Group-Based Assessment, Online Collaborative Learning, Higher Education.*

1.1 Introduction

The integration of peer assessment (PA) in online collaborative learning (OCL) has gained significant attention as a promising strategy to foster student engagement and improve learning outcomes in higher education (Adesina et al., 2022). Peer assessment allows students to evaluate each other's work, providing valuable opportunities for critical thinking, self-reflection, and feedback exchange, which are essential components of collaborative learning (Yundayani, Alghadari, & Odewumi, 2019). However, while peer assessment holds substantial potential, its implementation in OCL environments is often hindered by a variety of challenges, including technical, pedagogical, and social barriers (Babik et al., 2024; Zheng, Zhang, & Cui, 2019). Technologically, the effective integration of peer assessment systems often faces limitations in the usability and accessibility of digital tools, which can negatively affect student engagement and the quality of peer feedback (Donia, 2021; Kerman et al., 2024). Pedagogically, the lack of clear assessment rubrics, insufficient training for students on how to provide constructive feedback, and inadequate guidance on how to assess peers effectively often contribute to inconsistent evaluations and poor learning outcomes (Karami & Rezaei, 2015). Socially, issues such as trust, fairness, and the anxiety students experience when evaluating their peers' work can undermine the effectiveness of peer assessment (Double, McGrane, & Hopfenbeck, 2020; Rezaei & Shirazi, 2024). Despite these challenges, there is a growing recognition of the need for a comprehensive framework that addresses these factors and supports the effective implementation of peer assessment in OCL environments (Andrade, 2019; Ahmed & Sidiq, 2023). As institutions continue to embrace digital transformation, the development of strategies and frameworks that enhance the design and execution of peer assessment processes is crucial for optimizing the benefits of online collaborative learning (Celeste & Osias, 2024; Haleem et al., 2022). Thus, this paper proposes a comprehensive peer assessment framework for OCL that incorporates technological, pedagogical, and social considerations, with the aim of improving the overall learning experience and student outcomes in higher education.

The primary objectives of this paper are to identify and analyze the key factors influencing the effective implementation of peer assessment in online collaborative learning (OCL) environments. It aims to propose a comprehensive framework for implementing peer assessment in group based assessment for higher institutions of learning in eLearning environment, addressing technological, pedagogical, and social considerations. Furthermore, the paper seeks to discuss the potential implications of this framework for enhancing student engagement, improving learning outcomes, and fostering a more effective and collaborative learning experience in online educational settings.

2. Literature Review

Peer Assessment in Higher Education

Peer assessment has been recognized as an effective tool in higher education for enhancing student learning, developing critical thinking, and fostering collaborative skills (Topping, 2017). By engaging in the assessment of peers' work, students not only reinforce their understanding of

course content but also develop important skills in providing constructive feedback, self-reflection, and evaluation (Liu et al., 2020). However, the successful implementation of PA in online environments requires careful planning and a structured approach to ensure that students engage meaningfully in the process and that the feedback provided is valuable and reliable (Boud & Molloy, 2013).

Several studies have highlighted the challenges faced in implementing PA in online collaborative learning environments. Many institutions lack the necessary digital tools to facilitate PA, such as platforms for submitting and reviewing assignments, providing feedback, and tracking progress (Boud & Soler, 2016). Without clear guidelines, rubrics, and sufficient training, students may struggle to provide constructive feedback, leading to inconsistency and lack of value in the peer assessment process (Liu et al., 2020). Trust and fairness are key concerns in PA. Students may feel uncomfortable evaluating peers' work due to fear of damaging relationships or bias, leading to reluctance in engaging in the assessment process (Papinczak et al., 2007).

Reluctance to engage in the peer assessment (PA) process is a well-documented challenge, particularly in online collaborative learning environments. Students often hesitate to participate in the peer evaluation process due to concerns about fairness, trust, and the potential negative consequences of offering critical feedback to their peers (Papinczak, Young, & Groves, 2007). This reluctance can be attributed to several factors, including a lack of clarity around the assessment process, insufficient training, and the anxiety associated with critiquing peers' work. As a result, students may either refrain from providing meaningful feedback or offer overly lenient evaluations that fail to contribute to the learning process. To overcome these barriers and ensure the effective implementation of PA in online environments, research has identified several best practices.

First and foremost, providing clear rubrics and guidelines is essential. Well-defined assessment criteria help students understand the expectations of the process, ensuring that they are able to make consistent and fair evaluations (Sluijsmans et al., 2013). Rubrics also offer transparency, which can help to mitigate concerns about bias or unfairness in the peer review process.

Additionally, training and support for both students and instructors are critical for improving the quality of the PA process. Research indicates that equipping students with the skills needed to assess peer work objectively, give constructive feedback, and manage potential conflicts can significantly enhance the reliability and effectiveness of peer evaluations (Liu et al., 2020). This training also prepares students to handle the social dynamics of PA, addressing the challenges related to giving and receiving feedback.

Finally, building trust within the learning community is crucial for successful PA implementation. Students must feel that the peer assessment process is fair, transparent, and conducted in a supportive environment where their feedback is valued and respected. Creating such an atmosphere fosters greater participation and encourages students to engage more fully in the assessment process (Falchikov, 2005). By incorporating these best practices, educators can

enhance the quality and effectiveness of peer assessment in online collaborative learning environments, ultimately leading to better student engagement and learning outcomes.

3. Methodology

In this study, we employed the DeLone and McLean Information Systems Success Model (DeLone & McLean, 2003) as a theoretical framework to guide the development and evaluation of the proposed peer assessment (PA) framework to support group-based assessment in eLearning environments. The DeLone and McLean framework is widely recognized for its comprehensive approach to assessing the success of information systems, focusing on six interrelated dimensions: System Quality, Information Quality, Service Quality, Use, User Satisfaction, and Net Benefits. This framework was particularly suitable for evaluating the complex interplay of technological, pedagogical, and social factors that influence the implementation of PA systems in online learning contexts.

To gather relevant data and assess the key factors impacting the implementation of PA, we conducted surveys with students and instructors involved in online collaborative learning environments for group-based assessment. The surveys were designed to capture a wide range of experiences and perceptions related to PA practices, including the quality of peer feedback, system usability, student engagement, and the effectiveness of training. The questionnaires incorporated both closed and open-ended questions, allowing participants to provide quantitative responses as well as qualitative insights.

Following the survey, we developed a proposed framework for implementing peer assessment to support group-based assessment in online environments. This framework was informed by the survey findings and aimed to address the challenges and barriers identified in the existing literature, such as unclear rubrics, lack of training, and trust issues (Papinczak et al., 2007). The proposed framework emphasizes a comprehensive approach that integrates technological, pedagogical, and social considerations, with the goal of enhancing the effectiveness and reliability of peer assessments in online learning.

To validate and refine the proposed framework, we engaged in expert analysis. A panel of subject matter experts with experience in online learning, assessment practices, and educational technology provided feedback on the proposed framework. Their insights were used to assess the feasibility, relevance, and potential impact of the framework, ensuring that it aligned with best practices and addressed the key challenges identified in the literature and through the survey data. This expert analysis played a crucial role in ensuring that the proposed framework was both theoretically sound and practically applicable in real-world online learning environments.

Procedure and data collection

The study commenced after approval from the Mbarara University of Science and Technology Research Ethics Committee (Approval no.MUST-2024-1412) and by the Uganda National Council for Science and Technology (Approval no.SIR341ES). Permissions were also secured

from the heads or University Secretaries of the participating Universities, and informed consent was obtained from the participants. Detailed information about the study, including its purpose, procedures, potential risks, and benefits, was provided to participants. They were assured that their participation was voluntary and that they could withdraw from the study without any consequences.

4. Results

This section presents a comprehensive overview of the findings from the study on the implementation of a peer assessment framework in online learning, drawing from descriptive statistics from questionnaires and interviews, inferential statistics to identify key relationships, modeling analysis for predicting outcomes, and the expert review of the developed framework.

The data collected from the questionnaires and interviews provides an in-depth look at the demographics of the participants, their experiences with online learning, and their perceptions of the peer assessment framework.

The demographic data of the study participants revealed a diverse mix of ages, genders, roles, and experience levels. The majority (42.8%) were in the 25-34 age range, indicating a younger, potentially more tech-savvy group familiar with online learning platforms, while other participants were aged 35-44 (23.8%), 45-54 (14.3%), and 55-64 (19.0%), suggesting a broad range of perspectives on peer assessment. Gender distribution showed a slight male dominance, with 57.1% male and 42.9% female participants, offering a balanced view. The study also represented various roles, including lecturers (35%), technical staff (35%), and administrative staff (30%), ensuring a well-rounded representation of the online learning ecosystem. In terms of experience, a significant portion (33.3%) had 1-2 years of online teaching experience, with 23.8% having 3-4 years and 19.0% having 5-6 years, reflecting a relatively new group of online educators whose experiences may shape their attitudes toward peer assessment.

The interviews revealed that participants had a positive outlook on the peer assessment framework but highlighted several challenges, including technological barriers such as poor network connectivity, reliance on mobile devices, and electricity shortages. They also pointed to the need for improved communication channels, better access to collaborative tools, and ongoing professional development to ensure the framework's success.

Inferential statistics revealed key factors influencing student satisfaction with online collaborative learning and peer assessment. Communication channels played a crucial role, with satisfaction scores rising from 2.75 (low communication) to 4.25 (strong communication) when effective channels were in place. The use of social media groups for collaboration was also significantly associated with higher satisfaction, enhancing peer interaction and engagement. Instructor feedback emerged as another important predictor, with students rating their experience higher when feedback was provided. Additionally, collaborative tools like document editing and discussion forums were positively linked to student collaboration, highlighting their effectiveness in supporting the peer assessment process.

Modeling

Predictive Analysis of Satisfaction

The Predictor Importance graph for satisfaction with online collaborative learning activities highlights several key factors that significantly influence student engagement and satisfaction. Among the top predictors, social media communication channels were identified as the most important, emphasizing the role of platforms that foster real-time interaction and collaboration. Timely instructor feedback also emerged as highly significant, with students noting its direct impact on their learning experience, followed by the quality of instructor feedback, which was also deemed crucial for guiding students' progress. Peers' feedback, both in terms of timeliness and quality, was recognized as important but ranked slightly lower than instructor feedback. Video resources and collaborative tools, such as document sharing platforms, were found to have moderate and lower importance, respectively, in enhancing the collaborative learning process. Finally, feedback channels such as email were highlighted as essential for providing timely communication and feedback outside of regular class hours, ensuring continuous engagement and support for students in online settings. These insights underscore the importance of both communication tools and feedback mechanisms in shaping positive online learning experiences.

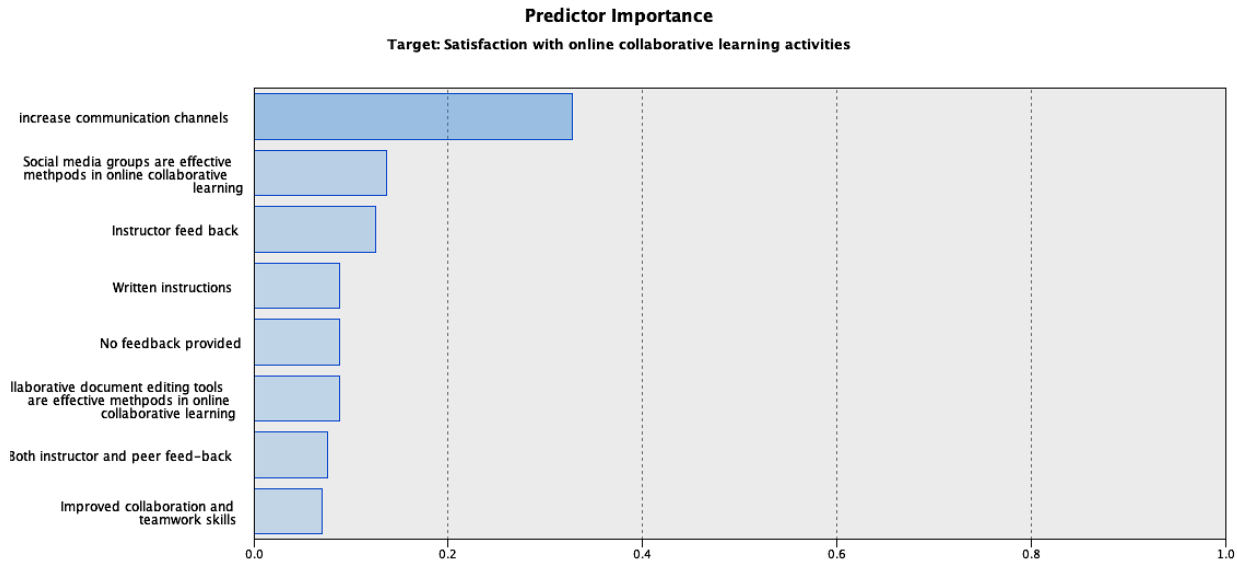


Figure 1: Expert analysis, Predictor importance

The analysis highlighted several key factors influencing student engagement in online collaborative learning. Although "Lack of Clear Instructions" was excluded as a predictor, it underscored the importance of clear guidance for effective participation. Experience in group-based learning emerged as a significant factor, with students who had prior experience being more engaged and effective in collaborative tasks. The effectiveness of online tools, such as collaborative whiteboards and discussion forums, was recognized, with students valuing these platforms for enhancing interaction. Familiarity with e-learning environments also proved crucial,

as students comfortable with online learning tended to benefit more from collaborative activities. Additionally, several other unspecified factors were noted as influential in online learning. The distribution of predicted satisfaction values revealed a generally positive outlook, with many participants rating their experiences favorably, particularly at satisfaction levels 3 and 4.

Forward Stepwise Regression Modeling was used to identify the most significant predictors of student satisfaction with online collaborative learning and peer assessment. The model included both demographic variables (e.g., experience in online learning) and operational variables (e.g., availability of communication tools, feedback mechanisms, etc.).

5. Framework design

In applying the DeLone and McLean Information Systems Success Model to the findings from the weighted least squares analysis and ANOVA, we can interpret the results understand the factors influencing the recommendation of online collaborative learning (OCL). The DeLone and McLean model identifies several key dimensions of information system success: system quality, information quality, service quality, use, user satisfaction, and net benefits. In this context, we can align the identified factors from the analysis with these dimensions.

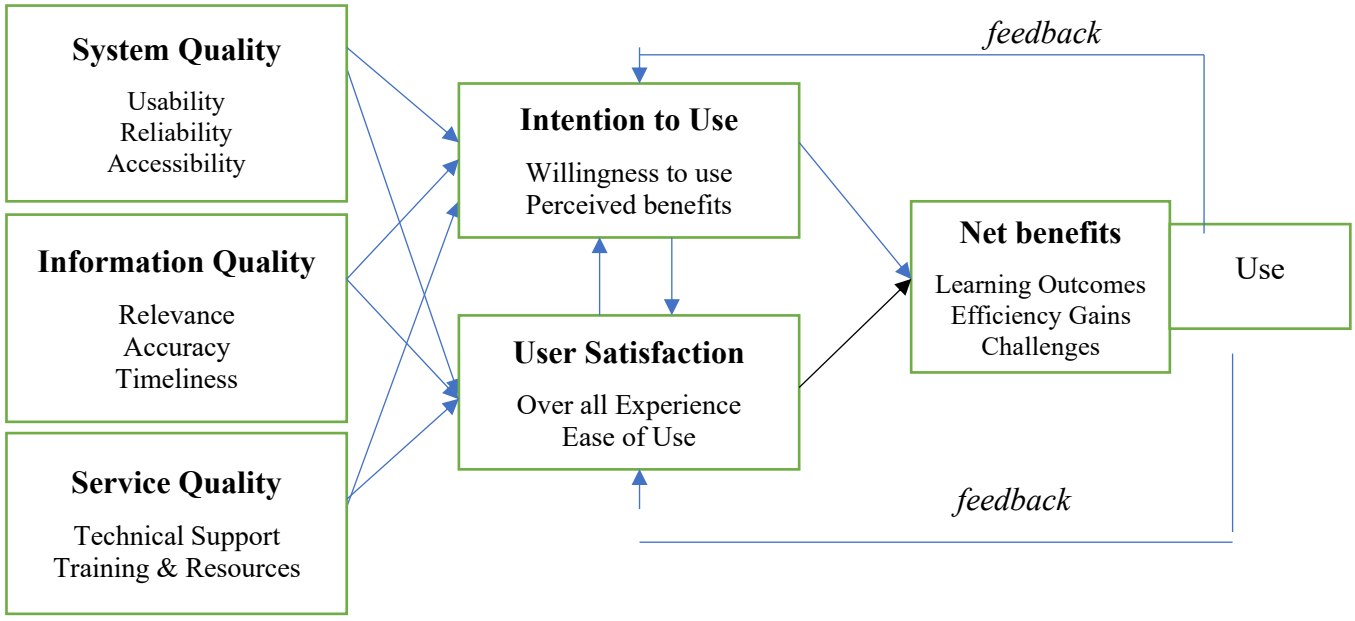


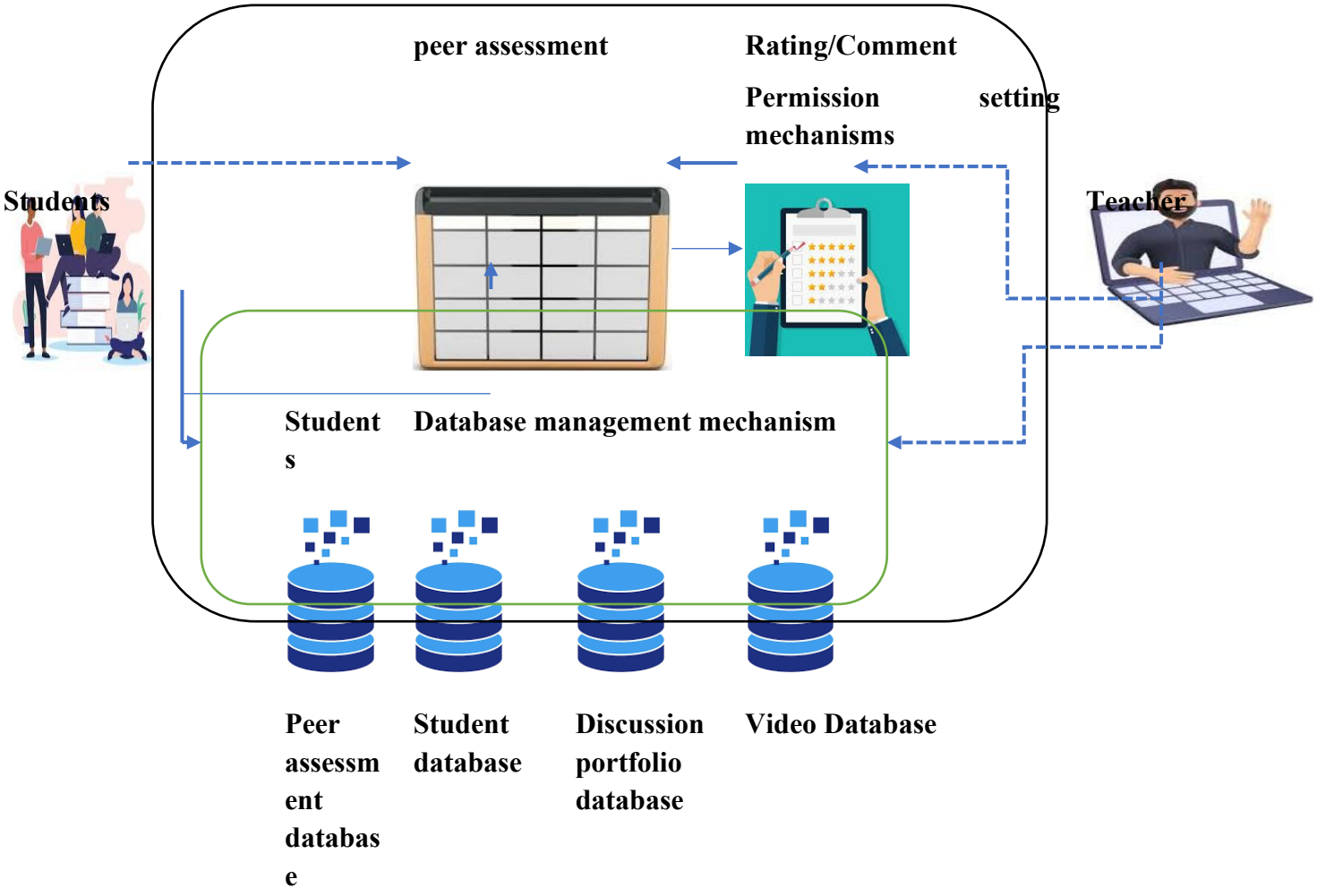
Figure 2: Proposed model

The analysis using the DeLone and McLean IS Success Model reveals that system quality, information quality, and service quality are key factors influencing the success of online collaborative learning (OCL). Effective tools and high-quality information about collaborative learning positively impact user satisfaction and the likelihood of recommending OCL. However, challenges or obstacles reduce the likelihood of recommendation, highlighting the need for strong

support. Interestingly, while engagement is important, it may lead to frustration if not paired with adequate support. Overall, the model explains 29.5% of the variance in recommendations, suggesting that while these factors matter, other elements may also contribute to OCL's success. Qualitative insights further emphasize the importance of usability, reliability, and support in enhancing the OCL experience.

Framework design

Peer assessment Learning framework



The online peer assessment framework for collaborative learning in universities should incorporate several essential features to enhance student engagement and learning outcomes. It should provide a peer review platform that supports the submission, review, and feedback process, be scalable to handle large numbers of students, and automate administrative tasks. The framework should facilitate social learning, enabling scaffolded and exploratory interactions, while promoting feedback literacy to help students give and receive constructive feedback.

Additionally, it should foster critical thinking, communication, teamwork, and empathy, which are valuable both academically and professionally. To boost student motivation and engagement, it should offer timely, formative feedback, support multiple reviewers, and ensure fairness through mechanisms like anonymized submissions. Adequate training for students and instructors, along with a reliable technological infrastructure, is crucial for effective implementation. Future research should focus on refining framework design and understanding its pedagogical impacts to further enhance the peer assessment process in collaborative learning environments.

Process design

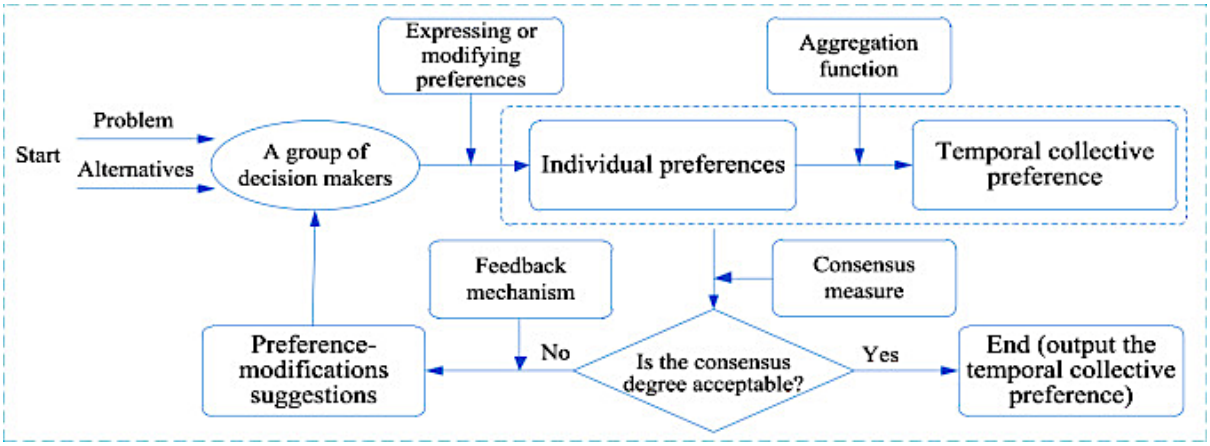
The process design for the online peer assessment framework includes various methods for marking strategies, ensuring flexibility and fairness in evaluating student contributions. The design should feature two main branches: Holistic Peer Marking and Criterion-based Marking.

Under Holistic Peer Marking, there should be three subdivisions:

1. Distribution of marks based on individual contribution, where the individual mark equals the total mark divided by each team member.
2. Marks awarded based on peer rating alone.
3. Instructor Moderated Peer Rating, which leads to two outcomes: individual mark equals average peer rating after instructor adjustment for fairness, or individual mark equals average peer rating adjusted for instructor moderation.

Under Criterion-based Marking, the design includes a performance-based rating, where the individual mark is a function of the relative or maximum performance (RP/MaxRP) times 100. This process design ensures that peer assessments are conducted fairly and accurately, reflecting both individual contributions and overall performance.

Preferences design

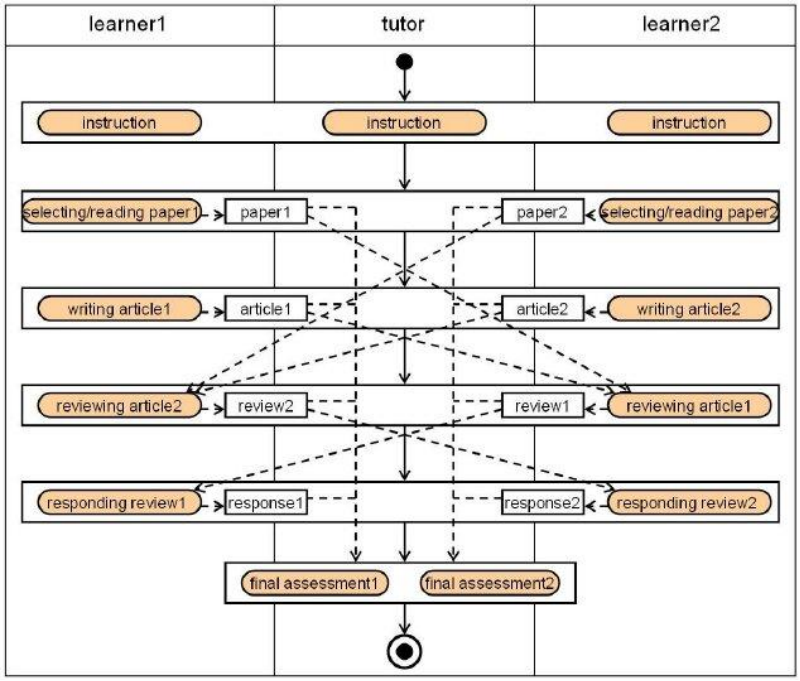


The design of the online peer assessment framework focuses on usability, flexibility, and customization to meet the diverse needs of students and instructors. The framework begins by identifying the problem and gathering input from decision-makers, which is then translated into

individual and collective preferences. It supports different user roles and permissions, allowing instructors to manage assessments while students submit and review assignments. Instructors can customize assessment criteria, deadlines, and feedback formats, with options for anonymous submissions and reviews to reduce bias. Feedback mechanisms include text comments, rating scales, and predefined templates, all configurable by instructors.

Users can set notification preferences for updates via email, in-app alerts, or push notifications, and accessibility features such as screen reader compatibility and adjustable text sizes ensure inclusivity. The framework prioritizes data privacy and security, with compliance to data protection regulations, and integrates seamlessly with existing Learning Management Systems (LMS). Customizable user interfaces enhance the overall experience, and support resources like tutorials, FAQs, and helpdesk services ensure users can navigate the system effectively. The aggregation function combines individual preferences into a collective preference, resolving any lack of consensus and providing a user-centered solution that fosters collaborative learning.

Peer assessment process model



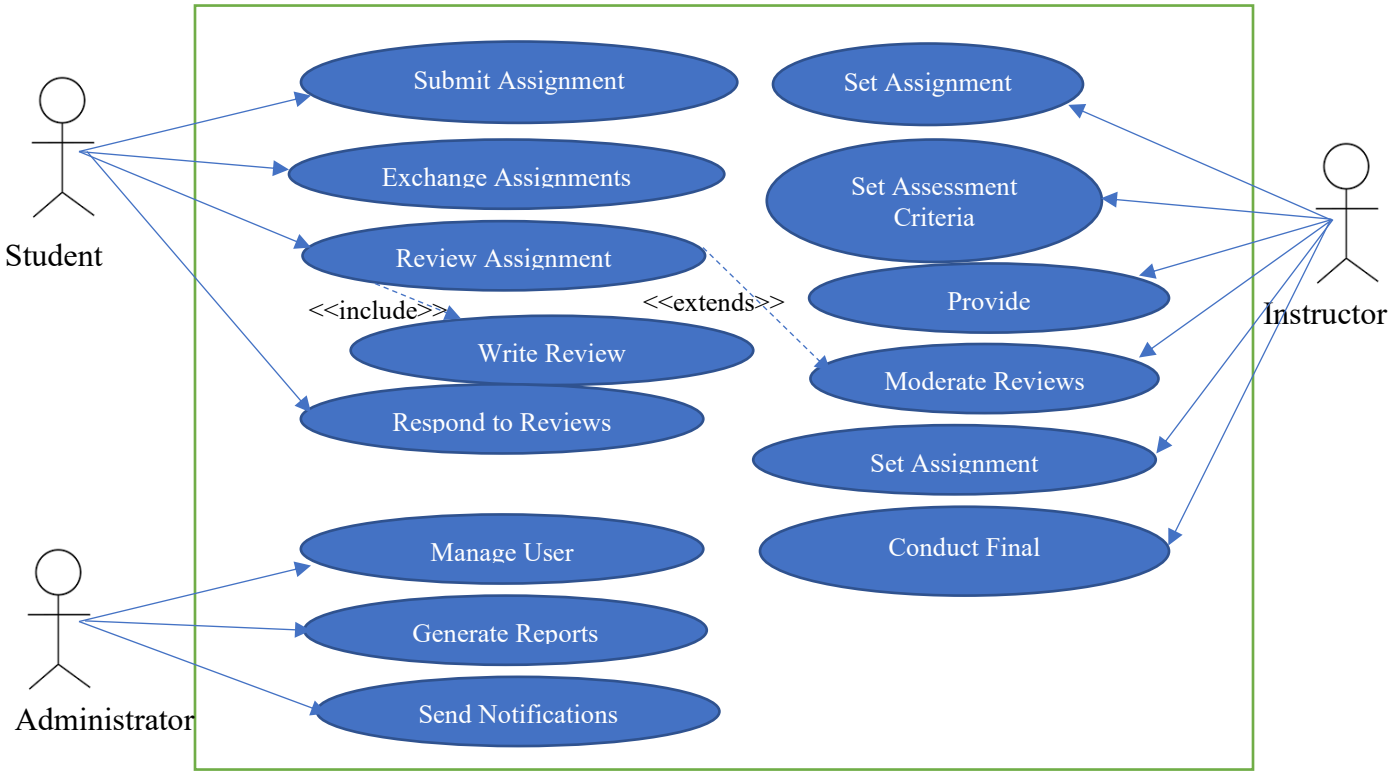
Instruction Phase

The instructional design phase begins with the tutor providing learners with detailed instructions regarding the assignment, including objectives, assessment criteria, deadlines, and guidelines for the peer review process. These instructions are delivered through the online learning platform, ensuring all participants have access to the same information. Learners then complete and submit their assignments (projects, classwork, or exercises) through the platform, which supports various file formats. After submission, the assignments are automatically exchanged between the learners

for peer assessment, with each learner reviewing their peer's work. The platform may anonymize submissions to ensure fairness.

Once learners receive the assignments, they thoroughly review the content, using tools provided by the platform (such as annotations or note-taking features) to analyze their peer's work. After reading the assignments, they write detailed reviews, offering constructive feedback and suggestions for improvement based on the assessment criteria. The review process is iterative, with learners reviewing each other's feedback and making revisions if necessary. The platform facilitates communication, allowing learners to respond to reviews and engage in constructive discussions. The final stage involves the tutor conducting a comprehensive assessment of the learners' work, including original submissions, peer reviews, and responses. The platform also includes features like notifications, analytics, and support resources to ensure smooth interaction and track progress throughout the peer assessment process.

Use Case model for Online peer assessment for collaborative learning



In the use case above, we designed a detailed use case diagram that encapsulates the various interactions among actors and the system itself. The primary actors involved in this system include students, instructors, and the system administrator. Students are the main users who engage with the platform by submitting assignments, reviewing peer work, and providing feedback. Instructors facilitate the learning process by setting assessment criteria, providing instructions, and conducting final assessments based on the peer reviews. The system administrator oversees the overall functionality of the platform, managing user accounts and generating reports on user engagement and performance.

Within the system boundary, several critical use cases are identified. Students begin their interaction by submitting their assignments through the platform. After submission, the system automatically exchanges these assignments for peer assessment, ensuring anonymity where necessary. Once students receive their peer assignments, they engage in a review process that includes accessing the submissions, critically evaluating them, and writing detailed reviews that offer constructive feedback. Following this, students have the opportunity to respond to the feedback they receive, fostering a dialogue that enhances learning outcomes.

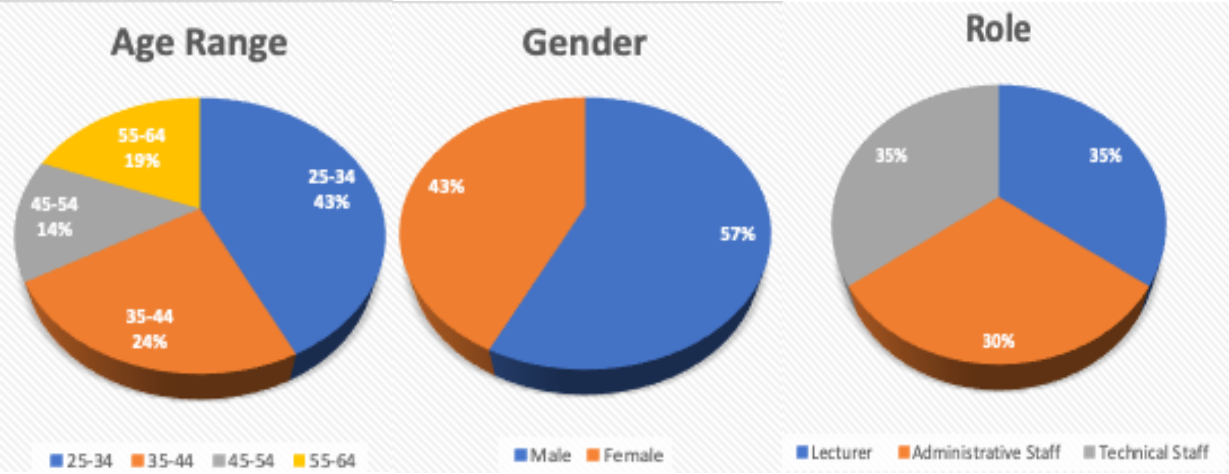
Instructors play a pivotal role by defining the assessment criteria and communicating essential information regarding assignments and deadlines to students. They also moderate the peer reviews, ensuring that feedback is fair and of high quality, and ultimately conduct the final assessment of submissions by considering both peer evaluations and the students' responses. This collaborative process ensures that students receive comprehensive feedback on their work.

The system administrator's responsibilities include managing user registrations and permissions, ensuring that all participants have appropriate access to the system. Additionally, the system generates reports that provide insights into student performance and engagement, enabling continuous improvement of the learning environment.

To illustrate the relationships between actors and use cases, the diagram employs solid lines to connect each actor to their relevant use cases, demonstrating the direct interactions. Dashed arrows are used to indicate the "include" and "extend" relationships among use cases, clarifying how certain actions are interconnected. For instance, writing a review is included in the review assignment process, and responding to reviews is included in the act of writing a review. Moreover, the moderation of reviews may extend from the review assignment if specific issues arise.

Expert Review of the Framework

The expert review involved 21 administrative staff, technical staff, and lecturers, who were asked to evaluate the proposed peer assessment framework based on their expertise and practical experience with online learning. Their feedback provided critical insights into the feasibility, challenges, and potential improvements for the model.



Framework Validation

The framework validation process revealed strong agreement among experts on the core elements of the peer assessment framework, such as the importance of clear instructions, effective feedback mechanisms, and strong communication channels. However, experts raised concerns about the lack of adequate technical support and the necessary infrastructure to implement the framework successfully. Many institutions, especially those in under-resourced settings, do not have the technical resources to support the widespread use of collaborative tools, which could hinder the framework's effectiveness.

Experts identified key challenges related to technological infrastructure and training needs. They noted that many existing online learning platforms were insufficient to support the collaborative tools required for effective peer assessment. To address this, they recommended investing in better infrastructure and providing technical support to both students and faculty. Experts also emphasized the need for ongoing training and professional development for faculty and students to ensure effective use of the peer assessment tools. They suggested regular workshops and refresher courses as essential for maintaining engagement and competence.

In terms of improvements, experts proposed developing a dedicated monitoring app to track student engagement and assess the effectiveness of the peer assessment process. This app could collect metrics on usage frequency, knowledge gain, skills development, and attention span. Additionally, they recommended increased collaboration between faculty and administrators to ensure the necessary resources and support systems are in place for successful implementation. Experts also highlighted the importance of clear communication, adequate training, and improved infrastructure as crucial factors for the success of the peer assessment framework, urging continuous evaluation and refinement to align with technological advancements and the evolving needs of students and faculty.

6.Discussion of results

The findings from the study offer valuable insights into the factors influencing the success of the peer assessment framework in online collaborative learning environments. Both the quantitative and qualitative data revealed several key factors that contribute to student satisfaction, engagement, and overall effectiveness of the framework. These include communication channels, feedback mechanisms, technological infrastructure, and the provision of clear instructions. The alignment between expert feedback and statistical results highlights the critical importance of these factors, reinforcing the idea that peer assessment is most effective when supported by robust communication and feedback systems (Anderson, 2022; Boud & Soler, 2016).

One of the most significant findings is the role of communication channels in enhancing student satisfaction. In the quantitative analysis, the presence of strong communication channels was significantly correlated with higher satisfaction, and this finding was corroborated by the expert reviews. Experts emphasized that clear and effective communication is crucial for fostering student engagement, which is essential in collaborative learning settings (Topping, 2018). Effective communication not only ensures that students understand the peer assessment process but also facilitates ongoing interaction and feedback, which are key to improving learning outcomes (Gikandi et al., 2011). The consistency between the statistical data and expert insights suggests that communication is a fundamental pillar for successful peer assessment frameworks.

Additionally, feedback mechanisms emerged as a critical factor in shaping student satisfaction and engagement. The statistical analysis showed that timely and constructive feedback, both from instructors and peers, positively influenced satisfaction levels. Experts echoed this sentiment, emphasizing that feedback is essential for students to reflect on their work and make improvements. This finding is consistent with the literature on peer assessment, which suggests that effective feedback encourages critical thinking and enhances the quality of learning (Nicol & Macfarlane-Dick, 2006). However, experts also pointed out the challenges of providing timely and meaningful feedback in large online learning environments, highlighting the need for systems that can streamline the feedback process and support sustained engagement (Hughes et al., 2019).

Technological infrastructure and training were identified as significant challenges that could limit the effectiveness of the peer assessment framework. Both the quantitative data and expert reviews indicated that without adequate support and resources, the peer assessment model would struggle to succeed. For example, experts noted that many institutions lack the necessary infrastructure to support collaborative tools effectively. This finding aligns with research that has highlighted the digital divide in education, particularly in under-resourced institutions where access to technology is limited (Selwyn, 2016). Furthermore, the need for ongoing training for both students and faculty was a common theme. Experts suggested that continuous professional development is necessary to ensure that users can navigate the peer assessment tools effectively. This echoes the findings of previous studies that have emphasized the importance of training in maximizing the potential of online learning systems (Hattie & Timperley, 2007).

The study also highlighted the importance of monitoring and evaluation of the peer assessment process. Experts proposed the development of dedicated monitoring tools to track student engagement and the effectiveness of peer assessments. This suggestion aligns with research on learning analytics, which has emphasized the role of data in improving the quality of education and student outcomes (Siemens, 2013). The integration of analytics into peer assessment platforms can provide real-time insights into student performance, engagement levels, and areas needing improvement, thus supporting more informed decision-making for both instructors and students (Dawson et al., 2019).

Finally, system customization emerged as a critical element for ensuring the system's effectiveness across diverse learning contexts. The flexibility to customize feedback formats, anonymity settings, and assessment criteria was seen as an important feature in the expert reviews. This customization aligns with findings from research on personalized learning environments, which argue that adaptive systems that cater to individual learning preferences lead to better engagement and learning outcomes (Brusilovsky & Millán, 2007). However, the successful implementation of such customization requires robust technological infrastructure and administrative support, further emphasizing the need for adequate resources.

7.Conclusion

This study highlights the key factors that influence the success of peer assessment in online collaborative learning environments, including clear communication, effective feedback mechanisms, strong technological infrastructure, and proper training for both students and instructors. The findings suggest that when these factors are well-supported, student engagement and satisfaction are significantly improved. However, challenges such as inadequate resources and the need for ongoing professional development were also identified. Moving forward, institutions should focus on strengthening their infrastructure, providing continuous training, and integrating monitoring tools to enhance the peer assessment process. By addressing these areas, peer assessment can become a more effective and valuable tool for online learning.

In conclusion, the findings of this study suggest that successful implementation of a peer assessment framework in online collaborative learning environments say for group-based assessments for students depends on multiple factors, including communication channels, feedback mechanisms, technological infrastructure, and training. The alignment between statistical results and expert insights reinforces the importance of these factors in promoting student satisfaction and engagement. However, challenges related to infrastructure and the need for ongoing training highlight the necessity of institutional support and continuous evaluation of the framework. Moving forward, integrating monitoring tools and enhancing system customization will be crucial for improving the effectiveness of peer assessment in online learning. As such, educational institutions must invest in both technology and professional development to ensure the successful implementation of collaborative learning tools.

8.Declarations

Funding

The study was funded primarily by the researcher, with additional support provided by Bishop Stuart University

Ethical Considerations

The study was approved by Mbarara University of Science and Technology Research Ethics Committee (Approval no.MUST-2024-1412) and by the Uganda National Council for Science and Technology (Approval no.SIR341ES). The researcher conducted the study in compliance with all applicable ethical standards and regulations.

Informed consent Informed consent was obtained from the participants to participate in the current study. They also consented to publishing the anonymous data of the study.

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