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Comparing Knowledge Gains in Online vs. Face-to-Face Learning: The Role of Student Interaction and Engagement in QAA-Certified Nepalese Colleges

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ABSTRACT

Research Aims: The educational landscape has undergone profound transformations driven by technological advancements, global events, and societal shifts. In this context, the study aims to examine the comparative knowledge gains in online versus face-to-face learning, focusing on the role of students' interaction and engagement.

Design/methodology/approach: Utilising Social Learning Theory and the Theory of Education, this paper adopted a deductive reasoning approach. Additionally, the study has incorporated cross-sectional, descriptive, causal, and relational research design. A structured questionnaire was administered to students, yielding valid responses from 110 participants enrolled in Quality Assurance and Accreditation (QAA)-certified colleges in the Kathmandu Valley. The collected data were analysed using descriptive statistics (mean, median, standard deviation, variance, kurtosis, and skewness), as well as correlation, regression, and mediation analyses.

Research Findings: The study ~~identifies~~ indicates student engagement as a partial mediator in the relationship between learners' interaction and knowledge gain. Both student interaction and engagement have a significant positive impact on knowledge gain, with the relationship being statistically significant at the 0.01 level with large effect size for all three regression models

Theoretical Contribution/Originality: The study findings suggest that implementing online learning strategies can improve educational outcomes, providing valuable insights for educational institutions and policymakers. The study results underscore the significance of integrating digital learning approaches to enhance student achievement.

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Introduction

Educational technology is rapidly evolving to expand access for learners who cannot fully benefit from traditional instructional methods (Haleem et al., 2022). As education adapts to a technologically advanced era (Nur, 2022), technology has increasingly become integrated into everyday activities, including teaching and learning (Carreon et al., 2022). While technology offers new modes of content delivery, traditional classroom-based instruction continues to play a vital role in achieving learning goals (Aoe et al., 2023). Various learning models—such as blended, online, and face-to-face—each contribute differently to learning effectiveness (Nur, 2022). Face-to-face learning brings students and instructors together in socially interactive environments (Bonk & Graham, 2006), whereas online learning occurs remotely through digital platforms (Djamarah & Zain, 2002) and became especially crucial during COVID-19 (Carreon, Elladora, & Peresores, 2023). Despite its growth, some scholars argue that online learning cannot fully replicate the socialisation opportunities offered by in-person instruction (Banks & Faul, 2007). Nevertheless, the rapid expansion of distance education technologies is undeniable (Cummings, Foels, & Chaffin, 2013), particularly as they promote greater flexibility and accessibility (Anderson & Friedmann, 2010). The global pandemic has highlighted distance education (online learning) as a replacement for traditional face-to-face learning in Nepal (Sthapit, 2020). The online learning system and full-fledged online academic degrees were formally and institutionally launched in Nepalese universities with the foundation of Nepal Open University (NOU) in 2016 under the Nepal Open University Act 2016 (Sthapit & Shrestha, 2020).

However, the evolving learning environment has raised questions about whether students perceive differences in the knowledge gained from online versus face-to-face classes (Shrestha & Sthapit, 2021). Although many studies have compared learning outcomes across these modalities, fewer have examined the extent of knowledge students acquire in each format. Prior research has frequently highlighted the role of interaction in knowledge gain. For example, Platt, Raile, and Yu (2014) found that students perceived fewer interaction opportunities in online classes and reported slightly lower knowledge gain, indicating a positive relationship between interaction and learning. Similar patterns have been observed by Gray and Diloreto (2016), Sthapit and Shrestha (2020), Shrestha and Sthapit (2021), and Shrestha et al. (2021).

The growing adoption of online learning has further intensified debates about its effectiveness, particularly regarding student engagement and knowledge acquisition. While online platforms offer flexibility and accessibility, scholars argue that they may not fully replicate the social and participatory benefits of face-to-face instruction. Reduced engagement in online settings has been shown to negatively affect learning

(Simic, Zdravkovic & Ignjatovic, 2022). Moreover, studies such as Gray and Diloreto (2016) demonstrate that student engagement can mediate the relationship between interaction and knowledge acquisition in online environments. Despite these insights, limited research has compared these dynamics across both online and traditional modes of learning.

Given this gap, it becomes essential to examine not only the equivalence of knowledge gain between online and face-to-face instructions but also the underlying mechanisms influencing such outcomes. Therefore, this study aims to evaluate the comparative effectiveness of online versus face-to-face learning environments by investigating how student interaction and engagement contribute to knowledge gain, with a specific focus on the mediating role of student engagement in the relationship between interaction and knowledge acquisition across both instructional modes. To achieve this main objective, the specific purposes of the study are outlined below:

- To explore the relationship among students' comparative interaction, engagement, and comparative knowledge gain,
- To evaluate the impact of students' comparative interaction and engagement on comparative knowledge gain,
- To assess the mediating/ intermediary role of student engagement in the relationship between students' comparative interaction and comparative knowledge gain, and
- To determine the equivalence between online and traditional face-to-face modes of learning

Literature Review

One of the fundamental underpinnings of the study lies in social learning theory proposed by Bandura (1977). As per the social learning theory, knowledge is acquired through imitations and interactions with others, either directly or indirectly through media. Behaviour that is rewarded tends to be imitated, while discouraged behaviour is avoided. Driscoll (1994) also emphasised that learning entails evolving one's knowledge or behaviour to improve human performance over time. Furthermore, there is a crucial role of social interactions and communication in the learning process. Engaging in collaborative activities, discussions, and receiving feedback from both peers and instructors facilitates a deeper understanding of the subject matter. Through these interactions, individuals gain valuable insights and perspectives, allowing them to clarify concepts and test their comprehension (Driscoll, 1994).

Active engagement in social interactions enriches knowledge through dialogue and idea exchange. Lave and Wenger (1991) emphasised that learning occurs through participation in authentic activities within specific contexts, where knowledge is constructed via social interaction, problem-solving, and real-world engagement rather

than simply transmitted from teacher to learner. To enhance learning effectiveness, Bandura (1977) proposed four mediational processes—motivation, retention, reproduction, and attention. Baron (1970) applied the attention process to study how attraction to a model and the model's competence influence adult imitative behaviour. Similarly, Sthapit and Shrestha (2020) and Shrestha and Sthapit (2021) integrated social learning theory to explore the connection between interaction and knowledge gain.

This study also draws on Dewey's (1938) educational theory, which highlights experiential learning and active participation. Dewey advocated for student-centred education that addresses learners' needs, interests, and experiences (Freire, 1970), promoting hands-on involvement in meaningful activities and problem-solving (Bruner, 1960). Kolb (1984) further emphasized learning as an active process of experiencing, reflecting, conceptualizing, and applying knowledge. Göncü and Rogoff (1998) supported this perspective, showing through empirical research how interactions with peers and adults positively influence knowledge acquisition.

A study by Platt, Raile, and Yu (2014) asserted that knowledge gained is one of the key dimensions to the perceived equivalence of online and face-to-face classes, which is in line with the current study. When delving into individual studies comparing online and face-to-face course delivery, there appears to be a lack of consistency in results. Some of the findings mentioned equivalent knowledge gain in different modes of learning, they include the studies by (Khatony, Nayery, Ahmadi, Haghani, & Julkunen, 2009); (Brown & Park, 2015); (Smith, et al., 2015); (Sthapit & Shrestha, 2020); (Aoe, et al., 2023). On the other hand, many other empirical studies contradicted with the previously mentioned result (Cummings, Chaffin, & Cockerham, 2015; Matsunaga, 2016; Shrestha, Subedi, Koirala, Manandhar, & Baral, 2021; Nur, 2022). This variation may be due to a focus on individual cases, making it difficult to control for the type of knowledge gained (Platt, Raile, & Yu, 2014). Further, the prior amount of the experience with online classes also influences the perception on knowledge gain. Based on the reviews, subsequent hypothesis has been developed:

H_{01}: Effectiveness of online classes is not equivalent to that of face-to-face classes in case of knowledge gain.

Interaction has long been recognised as a vital component of the educational process (Anderson, 2003). However, defining this multifaceted concept precisely remains challenging, as it encompasses various exchanges among participants and elements of teaching and learning (Berge, 1999). Dewey (1938) described interaction as central to education—where students transform passive information into personally meaningful knowledge. A Nepalese study by Shrestha et al. (2021) at Chitwan Medical College emphasized the need to foster interaction on e-learning platforms to enhance knowledge delivery and student outcomes.

Similarly, Gray and Diloreto (2016) highlighted how interaction encourages students to consider diverse perspectives and question assumptions, facilitating knowledge gain. Sthapit and Shrestha (2020) also found that higher classroom interaction leads to superior knowledge acquisition. This extensive research underlines the fundamental role of interaction in education. Accordingly, this study aims to examine the effect of learners' interaction on comparative knowledge gain. In line with Gray and Diloreto (2016), interaction is also positively linked to student engagement, suggesting that increased interaction improves engagement. Based on this review, the following hypothesis has been formulated:

H_{02}: Students' comparative interaction exerts no impact on comparative knowledge gain.

H_{03}: Students' comparative interaction has no effect on students' engagement.

The concept of engagement stems from traditional classroom teaching and is known to positively influence critical thinking and academic outcomes (Simic, Zdravkovic, & Ignjatovic, 2022; Northey et al., 2015). Factors such as attitude, personality, motivation, effort, and self-confidence contribute to student engagement (Gray & Diloreto, 2016). By assessing these affective elements, instructors can design lessons that better promote active participation and interaction. Simic, Zdravkovic, and Ignjatovic (2022) found a positive and significant relationship between student engagement and knowledge acquisition, noting that engagement levels—and consequently knowledge gain—were lower in online settings. This aligns with Gray and Diloreto (2016), who reported engagement's significant impact on knowledge gain and identified it as a complete mediator between learners' interaction and knowledge acquisition. This suggests that interaction alone is insufficient to enhance knowledge without active engagement. Based on these insights, the following hypotheses have been formulated:

H_{04}: Students' engagement does not have any influence on comparative knowledge gain.

H_{05}: Students' engagement does not play intermediary role between Students' comparative interaction and comparative knowledge gain.

Based on the reviewed literatures, study incorporated the variables such as students' engagement (mediating variable) which were developed by Gray and Diloreto (2016) and Simic, Zdravkovic, and Ignjatovic (2022). Similarly, dependent variable (comparative knowledge gain) and independent variable (students' comparative interaction) were adopted from Platt, Raile, and Yu (2014), Shrestha and Sthapit (2021), Sthapit and Shrestha (2020), and Shrestha, et al. (2021). *Figure 1* exhibits the schematic framework of the variables underpinned in the current study.

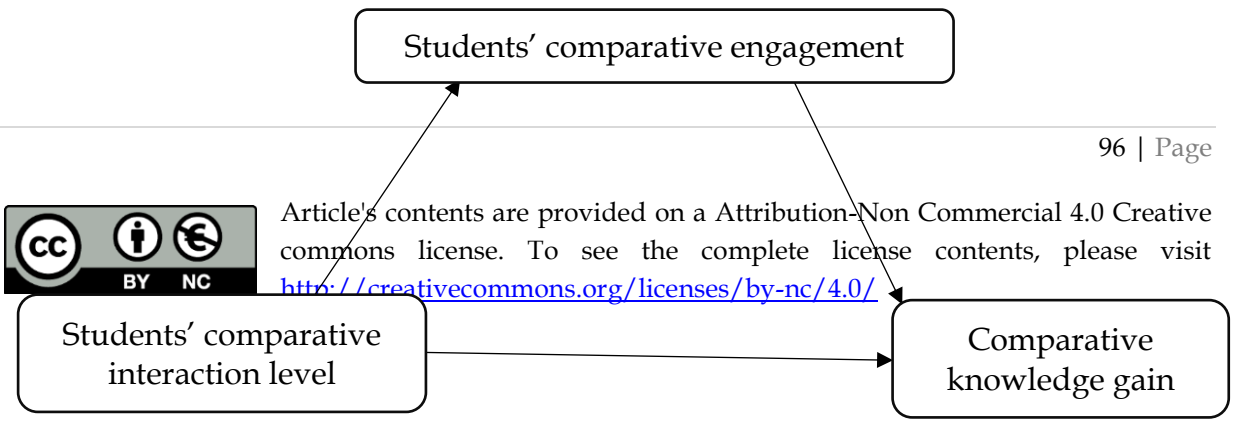

Figure 1 Research framework of the study

Interaction is a fundamental component of both online and face-to-face education. Moore (1989) developed a theoretical framework for remote education interaction before the rise of online learning, highlighting different types of interaction. This study focuses on two key forms: student-student and student-teacher interaction. Moore and Kersley (1996) defined student-to-student interaction as communication among students, which fosters motivation in the classroom. Classroom interaction is further supported by constructive feedback that affirms performance and suggests improvements (Muirhead, 2004). Teachers play a critical role in structuring classes to promote social interaction, known as student-teacher interaction. Roblyer (1999) noted that preferences for course delivery modes are linked to the value placed on communication with instructors and peers. In this study, students' comparative interaction encompasses communication between students and instructors, peer interactions, ongoing instructor feedback, and familiarity with both instructors and classmates.

Student engagement is defined as students' willingness, need, desire, and compulsion to participate and succeed in learning (Gray & Diloreto, 2016). It reflects students' interest, interaction levels, and motivation toward course content. Engagement is a multifaceted construct comprising behavioural, emotional, and cognitive dimensions (Fredricks, Blumenfeld, & Paris, 2004). Behavioural engagement includes observable actions such as sustained attention, participation, and absence of disruptions; emotional engagement covers positive or negative feelings towards teachers and peers; cognitive engagement involves the investment of mental effort to master skills. Handelsman et al. (2005) expanded this to include skills, emotional, participation/interaction, and performance engagement. The present study emphasizes motivation and effort within student engagement, considering factors such as timely assignment completion, active discussion, participation in activities, concentration, and emotional responses across different course delivery modes, all contributing to knowledge gain.

Knowledge gain refers to the retention and transfer of knowledge (Cortright, Collins, & DiCarlo, 2005) and serves as a key indicator of teaching effectiveness. Research comparing knowledge gain in online versus traditional face-to-face settings has yielded mixed results—showing positive effects, negative effects, or no significant

difference (Aoe et al., 2023; Hollerbach & Mims, 2007; Khatony et al., 2009; Nur, 2022; Platt, Raile, & Yu, 2014; Shrestha & Sthapit, 2021; Shrestha et al., 2021; Sthapit & Shrestha, 2020). These studies assess knowledge gain through various dimensions such as learning ability, information acquisition, understanding of course content, and motivation. This study defines knowledge gain as students' ability to absorb and understand course material, as well as their opportunities to learn effectively.

Method

This study analyses the impact of students' interaction and engagement on knowledge gain in both online and face-to-face learning modes. Employing a quantitative research design, the study uses deductive reasoning grounded in educational and social learning theories. A descriptive design was applied to capture the current situation, while a cross-sectional approach provided a snapshot of the population to explore patterns and relationships among key variables.

Specifically, the study examines the relationships between students' comparative interaction, engagement, and knowledge gain across both learning modes. Correlational analysis assessed these relationships, and a causal research design was used to evaluate the effects of interaction and engagement on knowledge gain as the dependent variable.

Population and sample

For empirical data collection, this study targeted QAA-certified colleges affiliated with various universities offering both bachelor's and master's programs across different faculties. According to Edusanjal (2017), as of January 2024, Nepal has 80 QAA-certified colleges, with 18 located in Kathmandu Valley, of which – only 10 colleges offer both bachelor's and master's programmes (see Appendix 1). Using - a purposive sampling, four colleges were selected: Janamaitri Multiple Campus, Kathmandu Model College, Koteshwor Multiple Campus, and Kathmandu School of Law (Appendix 2)–that represent 40% of the population, and their students formed the study population.

To select respondents within these colleges, convenience sampling was employed due to practical constraints—such as the festive season and ongoing examinations—which rendered exclusive reliance on physical questionnaires less feasible. Consequently, both online and physical distribution methods were adopted. Physical questionnaires were distributed between September 27 and October 29, 2024, and were self-administered following briefing sessions with the college authorities at the sampled institutions. Although this sampling approach facilitated a smoother data-collection process, it may introduce selection bias, as the respondents may not fully represent the broader student population.

The sample size for this study was initially calculated based on the standard deviation of 0.8333, appropriate for a 5-point Likert scale, as suggested by Bartlett, Kotrlik, and

Higgins (2001). The final sample size obtained was 110, which is considered acceptable, as it exceeds the minimum required sample size of 75 (calculated by multiplying the 15 questionnaire-items by 5), as posited by Gorsuch (1983). The sample size was deemed adequate for analysis, as it aligns with findings in existing literature where empirical studies have been conducted with comparable or smaller sample sizes, thereby supporting the sufficiency of the present study's sample (Fordis et al., 2005; Hollerbach & Mims, 2007; Khatony et al., 2009; Smith et al., 2015; Nur, 2022; Faidley, 2022).

Data collection and questionnaire

This study collected primary data through a questionnaire survey. A total of 120 questionnaires were distributed, with all returned; however, 10 were unusable, resulting in 110 valid responses—reflecting a high response rate. Since the population size was unknown, the sample size was determined without accounting for population parameters. Participants came from various programmes, including BBM, BBA, BCA, BA, LLB, MBS, MBA, and M.Ed.

The survey instrument employed a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) and was adapted from validated instruments in prior research without any modification to assess comparative knowledge gain between online and face-to-face classes. Variables and items were drawn primarily from Gray and Diloreto (2016), Platt, Raile, and Yu (2014), and some ranking questions from Simic, Zdravkovic, and Ignjatovic (2022). These sources reported Cronbach's Alpha greater than 0.75, depicting acceptable internal consistency. Hair et al. (2009) also asserted that a Cronbach's alpha value above 0.7 is acceptable for social science research. Likewise, confirmatory factor analysis (CFA) was conducted in this study using AMOS version 24, which exhibited an acceptable level of validity. Each variable was measured using five Likert-scale items, such as "*Compared to face-to-face classes, I discuss what I learned in online class.*"

The questionnaire began with an introduction explaining its purpose and assuring confidentiality. It collected demographic information (faculty, age, gender, online learning experience) followed by yes/no, multiple-answer, rank-order, and Likert-scale questions assessing students' knowledge acquisition across learning modes.

Result and Discussion

For data analysis, the study employed descriptive statistics such as mean, median, standard deviation, frequency, and percentage. Correlational analysis was used to examine relationships between variables, while simple regression analysed the impact of independent variables on the dependent variable. Additionally, mediation analysis was conducted to assess the mediating role of students' engagement between students' comparative interaction and comparative knowledge gain. –Data were collected

through a questionnaire as the primary research instrument. The acquired responses are then coded using excel. The coded responses were first analysed using IBM SPSS Statistics Version 20. For mediation analysis, AMOS software was employed. The resulting data were then reformatted in Excel and presented in both tabular and graphical formats.

The regression model used in this study is presented hereunder:

Main regression model:

$CKG = \alpha + \beta_1 CLI + \beta_2 CE + e_i$

Specific models:

- Effect of students' comparative interaction level on knowledge gain:

$CKG = \alpha + \beta_1 CLI + e_i$

- Effect of students' comparative engagement on knowledge gain:

$CKG = \alpha + \beta_2 CE + e_i$

- Effect of students' comparative interaction level on students' comparative engagement:

$CE = \alpha + \beta_1 CLI + e_i$

Where CLI= Comparative knowledge gain, CE= Students' comparative engagement, α = Intercept, CLI= Students' comparative interaction level, β_1= Coefficient of comparative learners' interaction level, β_2= Coefficient of students' comparative engagement, e_i= Error term

Table 1

Respondent Profile

Variable	Classification	Frequency	Percentage
Gender	Male	42	38.2
	Female	68	61.8
Age	Below 20	5	4.5
	20-30	101	91.8
	Above 30	4	3.6
Education level	Bachelor's	72	65.5
	Master's	38	34.5
Online learning experience	None	4	3.6
	Little	60	54.5

	Enough	46	41.8

Source. From the authors' survey, 2024

Table 1 presents an overview of the respondents' demographic characteristics. Among the 110 participants, the majority were female (61.8%), while 38.2% were male. Most respondents (91.8%) were aged between 20 and 30, with 4.5% below 20 and 3.6% above 30. Regarding education, 65.5% were bachelor's students and 34.5% were pursuing a master's degree. In terms of online learning experience, 54.5% reported having "not much" experience, 41.8% had "enough," and 3.6% had almost no experience.

Table 2

Descriptive statistics

Variable/Statistics	*N*	*Mean*	*Median*	*SD*	*Variance*	*Skewness*	*Std. Error of Skewness*
Students' comparative interaction	110	2.92	3.00	0.85	0.72	-0.24	0.23
Students' engagement	110	3.04	3.00	0.72	0.52	-0.14	0.23
Comparative knowledge gain	110	2.85	2.80	0.83	0.68	0.15	0.23

Source. From the authors' survey 2024

As shown in Table 2, the independent variable (students' comparative interaction) has a skewness of -0.24, indicating a slight leftward skew—most students reported higher interaction in online classes, though a few lower scores pulled the distribution left. The mediating variable (student engagement) also shows a mild left skew (-0.14), suggesting differences in engagement across modes. In contrast, the dependent variable (knowledge gain) exhibits a slight right skew (0.15), indicating that online learning may not fully match face-to-face learning in terms of the knowledge gained. Among the variables, student engagement recorded the highest mean (3.04), followed by interaction and knowledge gain. The highest median value (3) was observed for both the independent and mediating variables. Students' comparative interaction also showed the highest variability, with a standard deviation of 0.85 and variance of 0.72.

Table 3

Cross tabulation between gender and comparative ease to access study material in online versus face-to-face mode of learning

Gender	Comparative ease to access study materials		Total
	Yes	No	

Male	Count	26	16	42
	% within Gender	61.90%	38.10%	100.00%
Female	Count	23	45	68
	% within Gender	33.80%	66.20%	100.00%
Total	Count	49	61	110
	% within Gender	44.50%	55.50%	100.00%

Source. From the authors' survey 2024

Table 3 highlights gender-based patterns in the perceived ease of access to study materials. Among 42 male respondents, 61.9% (26) found it easier to access materials in online classes, while 38.1% (16) preferred face-to-face classes. In contrast, only 33.8% (23) of the 68 female respondents favoured online access, whereas the majority—66.2% (45)—found study materials more accessible in face-to-face classes. Overall, 55.5% of all respondents preferred face-to-face classes for ease of access, with a higher proportion of females expressing this view. Meanwhile, 49 respondents (44.5%) agreed that online classes provided easier access, while 61 (55.5%) disagreed. These findings suggest that face-to-face learning is generally perceived as offering easier access to study materials, particularly among female respondents. This suggests that female students tend to rely more on the physical (face-to-face) learning environment, whereas male students appear to exhibit greater technological confidence, which may contribute to their stronger preference for online classes.

Table 4

Impact of students' comparative interaction on comparative knowledge gain

Coefficients [a]	Unstandardised Coefficients		t	Sig.	F	Sig.	Adjusted R^2	Cohen's f^2	Hypotheses result
	B	Std. Error							
(Constant)	1.336	0.240	5.562	0.001					
Students' comparative interaction	0.519	0.079	6.571	0.001	43.173	0.001	0.279	0.387	Reject null hypotheses Significant at 0.01 level

[a] Dependent variable: Comparative knowledge gain

Source. From the authors' survey 2024

Table 4 delineates the impact students' comparative interaction on comparative knowledge gain. As evident in the result, there is a positive effect of students' comparative interaction on comparative knowledge gain with the regression

coefficient of 0.519. In another words, one unit increase in students' interaction results in 0.519 unit increase in knowledge gain. Similarly, ANOVA test examines whether regression model fits the data well. It is evident that the model fits well ($P < 0.01$) and prediction of regression is correct at 99 percent confidence level. Additionally, the model summary of students' comparative interaction exhibits the percentage of variation explained by independent variable on dependent variable. The results depict the adjusted R square value of 0.279. It indicates that students' comparative interaction explained 27.9 percent variation on comparative knowledge gain. For this model, a Cohen's f^2 is approximately 0.387 (with a coefficient of 0.519 and an adjusted R^2 of 0.279); it is greater than the flooring of 0.35. Therefore, it constitutes a large effect size, underscoring the practical importance and substantive contribution of the predictor variable in explaining variance in the outcome.

Table 5

Impact of students' comparative interaction on students' engagement

Coefficients a	*Unstandardised Coefficients*		*t*	*Sig.*	*F*	*Sig.*	*Adjusted R2*	Cohen's f^2	*Hypotheses result*
	B	Std. Error							
(Constant)	1.630	0.203	8.021	0.001					
Students' comparative interaction	0.483	0.067	7.237	0.001	52.375	0.001	0.320	0.471	Reject null hypotheses Significant at 0.01 level

a Dependent variable: Students' engagement

Source. From the authors' survey 2024

Table 5 presents the results of a regression analysis assessing the impact of students' comparative interaction on their engagement. The analysis reveals a positive and statistically significant relationship, with a regression coefficient of 0.483 ($p < 0.01$), indicating that higher levels of interaction are associated with increased engagement. This suggests a moderate effect of interaction on engagement, particularly in online settings. The model is significant at the 99% confidence level, confirming its adequacy in explaining the observed data. The adjusted R-square value of 0.320 indicates that 32% of the variation in student engagement is explained by students' comparative interaction. For this model, a coefficient of 0.483 and adjusted $R^2 = 0.320$ yields a Cohen's f^2 of approximately 0.471. This represents a large effect size, indicating that the predictor plays an important real-world role in accounting for differences in the outcome.

Table 6

Impact of students' engagement on comparative knowledge gain

Coefficients [a]	*Unstandardised Coefficients*		*t*	*Sig.*	*F*	*Sig.*	*Adjusted R^2*	*Cohen's f^2*	*Hypothesis result*
	B	Std. Error							
(Constant)	0.814	0.280	2.906	0.004					
Students' engagement	0.670	0.090	7.465	0.001	55.734	0.001	0.334	0.502	Reject null hypotheses Significant at 0.01 level

[a] Dependent variable: Comparative knowledge gain

Source. From the authors' survey 2024

The impact of student engagement on their knowledge gain is examined in *Table 6*. The findings revealed a positive effect of students' comparative interaction on students' engagement, as evidenced by a regression coefficient of 0.670. The regression coefficient suggests that students' engagement enhances knowledge gain by 67 percent in online class as compared to face-to-face class. For this model, a Cohen's f^2 value is approximately 0.502 (with a coefficient of 0.670 and an adjusted R^2 of 0.334); it is larger than 0.35. This represents a large effect size, indicating that the predictor variable is not only statistically significant but also substantively important in explaining variability in the outcome.

This outcome is statistically significant ($P < 0.01$) at a confidence level of 99 percent. The regression model captured the data patterns well with the p-value of 0.001, which is below the threshold of 0.01, signifying that the model fits well, and the predictions of the regression are accurate with a 99 percent confidence level. The variability explained by the students' engagement in relation to comparative knowledge gain is 0.334, indicating that 33.4 percent of the variability in comparative knowledge gain can be explained by students' engagement.

Table 7

Relationship between students' comparative interaction and comparative knowledge gain

Variables	Comparative learners' interaction	Comparative knowledge gain
Students' comparative interaction	1	
Comparative knowledge gain	.534** (0.001)	1

Hypotheses result	Significant at 0.01 level
	Null hypothesis is not accepted

** Correlation is significant at the 0.01 level (2-tailed).

Source. Calculations based on the data from authors' survey 2024

Pearson correlation analysis was performed to examine the relationship between students' comparative interaction and comparative knowledge gain. As per the *Table 7*, there is positive relationship between students' comparative interaction and comparative knowledge gain with a positive correlation coefficient value of 0.534. As students' comparative interaction increases in online classes relative to face-to-face classes, there tends to be a moderate increase in knowledge gain. Similarly, the relationship between students' comparative interaction and comparative knowledge gain is significant with P value less than 0.01 at a 99 percent confidence level or at 0.01 level.

Table 8

Relationship between students' comparative interaction and students' engagement

Variables	Comparative learners' interaction	Students' engagement
Students' comparative interaction	1	
Students' engagement	.571**	1
	0.001	
Hypotheses result	Significant at 0.01 level	
Result: null hypotheses not accepted		

** Correlation is significant at the 0.01 level (2-tailed).

Source. Calculations based on the data from authors' survey 2024

According to the findings presented in *Table 8*, a positive correlation coefficient of 0.571 indicates a positive relationship between students' comparative interaction and their engagement. It depicts that one unit increase in students' comparative interaction results in 0.571 increase in students' engagement. Moreover, the observed relationship is statistically significant, with a p-value below 0.01, significant at 99 percent confidence level or a significance level of 0.01.

Table 9

Relationship between students' engagement and comparative knowledge gain

Variables	Students' engagement	Comparative knowledge gain
Students' engagement	1	
Comparative knowledge gain	.583** (0.001)	1
Hypotheses result	Significant at 0.01 level	

Result: null hypotheses not accepted

** Correlation is significant at the 0.01 level (2-tailed).

Source. Calculations based on the data from authors' survey 2024

The findings show a strong positive correlation (r = 0.583) between students' engagement and comparative knowledge gain, indicating that higher engagement is associated with greater knowledge acquisition. This correlation is the strongest among the variables studied and is statistically significant at the 99% confidence level ($p < 0.01$).

Mediation analysis

Mediation analysis served as an analytical tool to elucidate the mediating role played by students' engagement in the association between students' comparative interaction and knowledge acquisition. By employing mediation analysis techniques, the study seeks to not only unveil the direct impact of students' comparative interaction on knowledge gain but also to discern the extent to which students' engagement functions as a mediator in this process. Baron and Kenny (1986) method, the most widely used method has been employed to test mediation. Initially, three conditions test has been carried out before examining mediation. It included causal relation between students' comparative interaction and students' engagement (denoted as a) students' engagement and comparative knowledge gain (denoted as b) and students' comparative interaction and comparative knowledge gain (denoted as c). Maximum likelihood method has been administered to estimate the causal relation between variables.

Table 10

Mediation analysis

Paths	Estimate

					Direct effect c	Indirect effect a*b	Total effect c+a*b	Mediation analysis
A	SE	←	CLI	0.483***	0.290	0.229	0.519	Partial mediation
B	CKG	←	SE	0.474***	0.01	0.01	0.01	
C	CKG	←	CLI	0.290***				

Source. Calculations based on authors' survey, 2024.

Furthermore, mediation analysis considered three types of effects, namely, direct effect, indirect effect and total effect (Hayes, 2009). As per the result shown in *Table 10*, the direct effect value is 0.290, indirect effect value is 0.229, and total effect value is 0.519. The results are significant at 0.01 level, as the P value of all three effects equals to 0.01. The significant result of both direct and indirect effect implies partial mediation of students' engagement between students' comparative interaction and comparative knowledge gain. It exhibits that student engagement explains some, but not all, of the relationship between students' comparative interaction and their knowledge gain. It suggests that while student engagement is an important factor, other factors also contribute to the effect of interaction on knowledge gain in online and face-to-face mode of learning.

Discussion of key findings

The study aimed to examine the mediating effect of student engagement on the relationship between students' comparative interaction and knowledge gain in online versus face-to-face course delivery. Additionally, it investigated the direct impact of students' comparative interaction and engagement on knowledge gain among students at QAA-certified colleges. The analysis yielded the following findings:

- A significant positive correlation was found between students' comparative interaction and engagement ($r = 0.571$, $p < 0.01$). Similarly, student engagement showed a strong positive correlation with comparative knowledge gain ($r = 0.583$, $p < 0.01$), and students' comparative interaction was also positively correlated with knowledge gain ($r = 0.534$, $p < 0.01$).
- Regression analysis revealed that students' comparative interaction positively influenced engagement ($\beta = 0.483$), while engagement had a strong positive effect on knowledge gain ($\beta = 0.670$). Additionally, the direct impact of students' interaction on knowledge gain was positive ($\beta = 0.519$). All effects were statistically significant at the 99% confidence level.
- Mediation analysis confirmed that student engagement partially mediates the relationship between students' comparative interaction and knowledge gain, with both direct and indirect effects significant at the 0.01 level.

- The study concludes that students' knowledge gain through online classes is not fully equivalent to that of face-to-face learning experiences.

In the aftermath of the COVID-19 pandemic, online learning has become a core component of education, transforming how students engage with academic content. What began as a temporary solution has evolved into a lasting and widely adopted model. In Nepal, the education sector continues to adapt, with educators embracing innovative strategies to ensure quality online delivery. The post-pandemic era has highlighted the value of blended learning—integrating online and traditional methods—to address the diverse needs of students nationwide. Against this backdrop, the current study assessed students' knowledge acquisition in online versus face-to-face learning. Based on a comprehensive literature review, the study identified key variables, focusing on the mediating role of student engagement in the relationship between students' comparative interaction and knowledge gain. It explored the influence, associations, and mediation effects among these variables.

The findings of this study indicate that students' comparative interaction positively influences knowledge acquisition in both online and face-to-face modes among bachelor's and master's students at QAA-certified colleges in the Kathmandu Valley. This aligns with Gray and Diloreto (2016), who reported a significant impact of interaction on perceived knowledge gain, as well as with Sthapit and Shrestha (2020) and Shrestha and Sthapit (2021), who similarly found interaction to positively affect knowledge acquisition. Additionally, students' comparative interaction is positively associated with student engagement, supporting Gray and Diloreto's (2016) conclusion that interaction fosters engagement, which in turn enhances learning by promoting diverse perspectives, feedback, and skills such as communication and teamwork.

Student engagement also showed a significant positive relationship with comparative knowledge gain, consistent with Simic, Zdravkovic, and Ignjatovic (2022). Active engagement through discussions, collaboration, and hands-on activities enhances attention, motivation, and investment in learning, thereby improving knowledge acquisition. Moreover, engagement partially mediates the relationship between interaction and knowledge gain in this study, differing from Gray and Diloreto's (2016) finding of full mediation; it indicates that knowledge gain may be influenced by multiple pathways beyond student engagement alone.

Regarding knowledge gain across the two learning modes, the data results reveal that online learning is not equivalent to face-to-face instruction. This finding supports Matsunaga (2016), who observed greater knowledge gain in online courses, and Cummings, Chaffin, and Cockerham (2015), who noted differences between the two modes. However, it contrasts with Platt, Raile, and Yu (2014), who found no greater knowledge gain in online courses, and with Shrestha et al. (2021), who reported fewer opportunities for knowledge acquisition online. Other studies (Hollerbach & Mims, 2007; Cummings, Foels, & Chaffin, 2013; Nur, 2022) suggest that online and face-to-

face learning provide equivalent knowledge gain, indicating no clear superiority of either mode.

These contradictory findings across studies suggest that knowledge gain is not solely determined by the mode of course delivery, but also by the context in which each mode is implemented. Studies reporting higher knowledge gain in online learning often reflect environments where online instruction was well-integrated and systematically structured. Similarly, the research showing no significant difference between the two modes of learning typically represents cases where both online and face-to-face formats were delivered with comparable consistency. Conversely, studies that observed lower learning efficacy in online settings highlight technological limitations and a lack of structured instructional design. Overall, these variations indicate that multiple contextual and pedagogical factors influence knowledge acquisition across different learning modalities.

Conclusion

This study examines comparative knowledge gains in online and face-to-face classes, emphasising student interaction as a key driver of learning. The findings show that student interaction significantly enhances knowledge acquisition by fostering communication, collaboration, and idea exchange, leading to deeper understanding and better learning outcomes. Interaction also boosts student engagement; however, its primary and more pronounced effect lies in enhancing knowledge gain rather than engagement alone. These results align with social learning and educational theories that highlight the crucial role of interaction and engagement in learning.

Student engagement further contributes to knowledge gain and amplifies the positive effect of interaction. Engaged students participate actively, making interactions—such as discussions, group work, and peer feedback—more meaningful and effective, thereby enriching knowledge acquisition.

Participants noted that online classes help maintain attention better, while face-to-face classes offer immediate clarification. Both male and female students reported easier access to study materials in face-to-face settings, although those with more online experience showed a preference for online learning. The study concludes that knowledge gain differs across modes, each providing unique strengths in interaction and engagement. The modestly higher level of knowledge gain observed in the online mode of learning may be attributed to environments that foster interaction and engagement. Online platforms support learning by allowing students to revisit instructional materials and progress at a flexible pace, giving them a greater sense of control—an element that can enhance engagement and, in turn, knowledge acquisition. Moreover, online settings facilitate structured and frequent interactions

through features such as chat functions, screen sharing, and discussion forums, which further contribute to the slightly higher knowledge gain reported in online classes.

These findings offer additional insights within the context of Nepal, as the present study includes students from both master's and bachelor's levels across multiple faculties in QAA-certified colleges—an area largely unexplored in previous comparative studies on course delivery modes. Furthermore, this study examines the mediating role of key variables, extending beyond earlier research works that have predominantly focused on direct effects within a single learning environment.

Based on these insights, educational institutions should adopt a blended learning approach that leverages the advantages of both online and traditional methods. For online courses, enhancing interactivity and multimedia use can improve engagement and focus. In face-to-face settings, emphasis should be on immediate support and hands-on activities. Training educators to effectively manage both environments and offering diverse learning resources can further optimise outcomes. Embracing such a flexible, integrated strategy allows institutions to maximise the benefits of each mode and improve overall educational effectiveness.

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Conflict of Interest

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Appendices

Appendix 1

List of QAA certified colleges in the Kathmandu Valley offering bachelor and master level programmes

SN	Name of colleges	Address
1	Janamaitri Multiple Campus	Kuleshwor, Kathmandu
2	Kathmandu University School of Education	Hattiban, Lalitpur
3	Kathmandu Model College	Bagbazar, Kathmandu
4	Kathmandu Bernhardt College	Bafal, Kathmandu
5	Pulchwok Campus	Pulchwok, Lalitpur
6	Koteshwor Multiple Campus	Koteshwor, Kathmandu
7	Baneswor Multiple campus	Shantinagar, Kathmandu

8	Kathmandu School of Law	Dadhikot, Bhaktapur
9	Jana Bhawana Campus	Chapagaun, Lalitpur
10	Kathmandu University School of Arts	Hattiban, Lalitpur

Appendix 2

List of sample colleges

SN	Name of colleges	Address
1	Janamaitri Multiple Campus (Tribhuvan University)	Kuleshwor, Kathmandu
2	Kathmandu Model College (Tribhuvan University)	Bagbazar, Kathmandu
3	Koteshwor Multiple Campus (Tribhuvan University)	Koteshwor, Kathmandu
4	Kathmandu School of Law (Purbanchal University)	Dadhikot, Bhaktapur