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Classroom Process Quality, Use of Technology, and Student Engagement: Mediating Effect of Academic Intrinsic Motivation among HEI's Students of Gujarat

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Abstract:
Classroom process quality in terms of instruction quality and use of technologies have affected the students' engagement in higher educational institutions across the globe. Moreover, students' motivation for learning also plays a crucial role in student outcomes. However, a holistic model for classroom process quality, academic intrinsic motivation and student engagement needs to be tested. The present study fills the gap by investigating the complex interplay between classroom process quality, use of technology, academic intrinsic motivation, and student engagement in HEIs. A study adopted a quantitative research design where responses from 296 students from HEIs across Gujarat state were collected. The result suggests that instructional quality as a measure of classroom process quality significantly influences student engagement. In contrast, the use of technology by faculties in the classroom does not influence student engagement. Similarly, academic intrinsic motivation indirectly mediates the relationship between instructional quality and student engagement and does not mediate the relationship between the use of technology and student engagement. This is the first of nature where the collective effect of classroom process quality (i.e. instructional quality and use of technology) on student engagement is assessed.

Keywords: Academic Intrinsic Motivation (AIM), Instructional Quality (CPQ), Use of Technology (UT), Student Engagement (SE)

Introduction

The significant loss of students due to dropouts in higher educational institutions (HEIs) drives this research. The Government of India report published in 2023 on student dropout across higher educational institutions and universities indicates that 32000 students dropped out from higher educational institutions between 2019 and 2023 (Ministry of Education, Government of India, 2023). Moreover, Gujarat has reported a 57% student dropout rate in higher educational institutions. HEIs should design various approaches to reduce the student dropout rate. One of the approaches to lowering dropout is fostering student engagement among HEIs students and motivating them to participate in their academic activities and involvement in their curriculums (Skinner et al., 2008; Virtanen et al., 2013). Previous studies confirm that student engagement among adult learners increases student retention in college (Spitzig & Renner, 2025).
Ensuring student engagement level is also a crucial challenge for HEIs (Bergahl et at., 2020; Raes et al., 2020; Wang et al., 2022). Shernoff et al. (2016) claimed that student engagement will be fostered in a learning environment where teachers are supportive and also depend on the quality of instructions and contents in the classroom. Classroom process quality, i.e., instructional quality, positively impacts student-related outcomes (Olivier et al., 2021). This can be enhanced using various technologies (interactive smartboards, internet of things, virtual realities, smart classrooms). The use of technology

will significantly improve the learning experience and learning outcomes (Shi et al., 2020). Furthermore, students' motivation toward academics also affects student engagement in HEIs (Skinner et al., 2009; Karimi & Sotoodeh, 2019).

The present study is unique because it has focused on how instructional quality is delivered in the class and how technology intersects and may influence student engagement in HEIs. The present paper aims to examine the collective effect of instructional quality and the use of technology on student engagement levels. Second, it investigates the mediating role of academic motivation between classroom process quality (instructional quality, use of technology) and student engagement. The present study addresses the following gaps in the research literature: First, past researchers have examined the mediating role of several constructs, such as learning goals (Foriland & Worrell, 2016), intellectual stimulation, and self-efficacy (Shil & Bolkon, 2021). However, the mediating role of academic motivation between classroom process quality and student engagement remained unexplored. Few researchers attempted to measure the relationships between classroom process quality, academic motivation, and student engagement (Karimi & Sotoodeh, 2019). The present study will fill that research gap.

Second, the present study used an advanced method for data analysis and hypothesis testing. Most previous researchers have used first-generation data analysis methods (Wheeler et al., 2007; Hassan et al., 2012; Peng et al., 2014). Second-generation methods, especially structural equation modeling, are recommended in social science studies where the nature of studies is complex (Conghlan & Mullen, 2008; Hair et al., 2021) and the mediating effect of a construct to be studied (Richter et al., 2016; Avkitan, 2017; Mumtaz et al., 2017; Roldan & Carrion, 2017). Limited use of PLS-SEM has been observed in academic research. The study will overcome the methodological gap by employing PLS-SEM.

Review of Literature

Classroom Process Quality and Student Engagement

The study is based on the three-dimensional model measuring overall classroom quality (Klieme et al., 2009). The application of three dimensions models, cognitive activation, supportive climate, and classroom management have been seen in HEIs studies (Atlay et al., 2019). As Klieme et al. (2009) described, cognitive activation involves fostering students' conceptual understanding using effective teaching strategies. This includes engaging students with challenging tasks and encouraging peer discussions within the learning environment. A supportive classroom atmosphere is built on positive social interactions, where teachers demonstrate care and provide constructive feedback. Classroom management extends beyond addressing disruptive behaviour; it requires teachers to maintain focus while establishing clear and consistent rules and expectations regarding academic content and social norms.

The use of technology in HEIs has gained the attention of researchers in recent years (Jou & Wang, 2019). Using technology along with classroom instructions will enhance students' learning outcomes. However, due to limited studies availability, further investigation is required to explore more insights into how the use of technologies with classroom quality enhances student outcomes (Hillmayr et al., 2020; Wang et al., 2022). Hence, the present study has integrated technology with three dimensions of classroom process quality to assess its effect on student engagement. The following hypotheses have been proposed:

H1: Instructional quality has a positive impact on student engagement.
H2: The use of technology has a positive impact on student engagement.

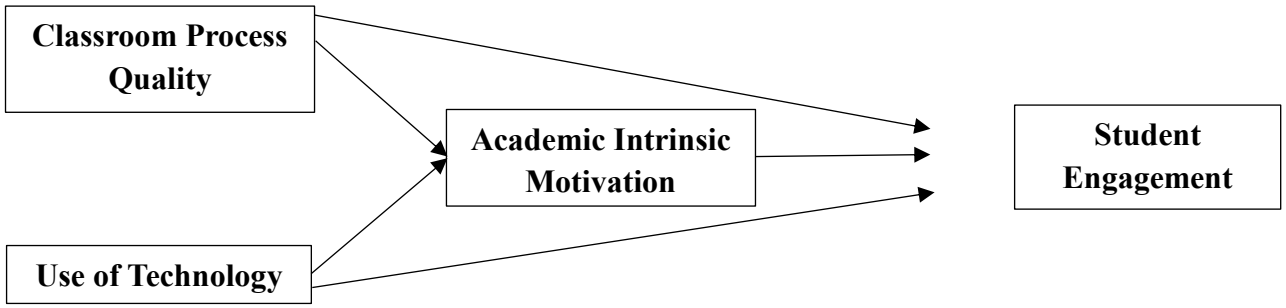
Mediating Role of Academic Intrinsic Motivation on Student Engagement

Academic intrinsic motivation is adopted from the theory of self-determination theory (Deci & Ryan, 1985). This theory has an application in business and education (Chen & Janh, 2010; Nicholson & Putwain, 2018). Ryan & Deci (2020) define academic intrinsic motivation as a sense of motivation to perform a task due to being enjoyable, optimally challenging, and aesthetically pleasing. Sun et al. (2018) confirmed that students with high levels of intrinsic motivation engage in learning activities and exhibit high levels of accomplishment and engagement (Areepattamannil et al., 2011; Saeed & Zyngier, 2012). Many previous studies have claimed that student outcomes, such as student achievements and academic engagement, depend on students' intrinsic motivation (Guay et al., 2008). Magtubo et al. (2022) proved that academic intrinsic motivation mediated the relationship between classroom process quality and student engagement. Moreover, this relationship has been explored in the context of secondary school. In line with the previous empirical findings, we proposed the following hypotheses:

H3: AIM mediates the relationship between instructional quality and student engagement.
H4: AIM mediates the relationship between the use of technology and student engagement.

Research Methodology
Based on the available literature reviews, the proposed research model has been developed:

Figure 1: Proposed Research Model



Sampling Design and Data Collection:

For the study, responses were collected from students studying in higher educational institutions (HEIs) across graduate and postgraduate levels in Gujarat, India. Data was collected from the students by adopting a non-probability convenience sampling method. The data collection process was initiated after obtaining permission from the institute's directors/principals/HoDs. Their role was crucial as they were responsible for authorizing the circulation of the online questionnaire among the students. This online mode of data collection was adopted to increase the response rate and to make it convenient for respondents. A total of 309 filled responses were recorded from the students. During the preliminary round of scrutinization, a questionnaire with missing data and biased responses was removed to improve the overall result of the study. After rigorous screening, 296 responses were carried forward for further data analysis.

Instrument Design:
A structured questionnaire was designed and administered in a self-reported manner to elicit primary data from the students studying in various HEIs of the Gujarat region. The instrument was developed by adopting multiple scales to measure the study constructs that had already been administered and validated.

Classroom process quality has been measured through instructional quality and the use of technology. The PI-SCALE of MacLeod et al. (2018) was chosen for its comprehensive assessment of cognitive activation and connectedness, key components of instructional quality. This scale was used to measure these aspects on a five-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Classroom process quality was also investigated through technology in the classroom. Two dimensions, digital devices, and resources, were chosen as they represent the most common forms of technology used in educational settings. The scale of Wang et al. (2019) was adapted for its focus on these dimensions and was used on a five-point Likert Scale, scoring from 1 (Never) to 5 (Very Much). *Academic Intrinsic Motivation* was measured using Gottfried's (1985) seven-item scale on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). *Student Engagement:* A ten-item scale of Jang et al. (2012) and Reeve & Tsend (2011) was used to assess the engagement level of students on a five-point Likert scale, scoring from 1 (strongly disagree) to 5 (strongly agree). A rigorous process was followed to develop the study instrument. First, the scale was refined by changing the words and making them easy to understand, as the initial scales were developed in the Western context. After the scale refinement, face validity was performed, and the questionnaire was given to two prominent academicians. They have thoroughly evaluated the instrument and suggested the changes. After incorporating the suggested changes in the instrument, a pilot test was administered where 40 students were randomly selected. The final version of the questionnaire was circulated to the respondents so that they could collect the data based on the suggestions received during the pilot testing phase. Demographic data such as age, gender, graduation level, and annual income were collected.

Results and Discussion:

Descriptive Statistics:

Table 1: Descriptive Statistics

Demographic Characteristics		**Frequency**	**Percentage**	**Total**
Gender	Male	136	46	**296**
	Female	160	54	
Educational Level	Graduate	139	47	
	Post-Graduate	157	53	
Annual Family Income	Less than 2.5 lakhs	113	39	
	2,50,000 – 5,00,000	83	28	
	5,00,000 – 7,50,000	37	12	
	7,50,000 – 10,00,000	33	11	
	More than 10,00,000	30	10	

Table 1 showcases the summary of descriptive statistics of the responses. Responses were reported to be 296, among which 160 were female respondents, while 136 male respondents filled out the questionnaire. 139 graduated students filled out the questionnaire, and 157 post-graduate students returned the filled questionnaire. The following responses were recorded for family annual income: 113 students' family income was reported below 2,50,000, 83 students belonged to the yearly income category of 2,50,000 – 5,00,000, and 33 students had an annual family income greater than 10 lakhs.

Data Analyses:

Generally, four steps must be performed for data analysis in which the proposed model needs to be tested. The first two steps, exploratory factor analysis

(EFA) and confirmatory factor analysis (CFA) were adopted to assess the model fit. The second two stages include evaluating the proposed model by considering the measurement and structural models with data collected and variables used in the study.

EFA is a common method used in social science to identify the factor structure. In the present study, EFA was not performed. The rationale is that when researchers clearly understand the latent construct and their measures, they can eliminate the EFA and directly perform the CFA. In the present study, scales used for measuring the constructs were adopted based on the works of literature, and past researchers have validated scales.

CFA is used to confirm that particular variables are part of that construct only and do not belong to any other construct. Scale reliability and validity were assessed before assessing the proposed model of the study. Table 2 presents Cronbach's alpha result for various constructs.

Table 2: Cronbach's Alpha of Various Constructs

Construct	No of Items	Cronbach's Alpha Value
Instructional Quality (IQ)	18	0.952
Use of Technology (UT)	04	0.690
Academic Intrinsic Motivation (AIM)	07	0.907
Student Engagement	10	0.951

The value of Cronbach's alpha presented in Table 2 is above the threshold value of 0.80 (Cronbach, 1952; Nunnally. 1978). Hence, the scale has a high level of internal consistency and reliability.

Confirmatory Factor Analysis (CFA):

Various indices were adopted to perform the confirmatory factor analysis in the present study. The recommended level of fit indices suggested by Bagozzi and Yi (1988), Doll et al. (1994), Baumgartner and Homburg (1996), and Hair et al. (2019) and the estimated model value can be seen in Table 3.

Table 3: Fit Indices

Fit Index	Estimated Model Value	Acceptable Value	Interpretation
P Value	0.000	<0.05	Supported
Chi-square/df	2.927	Between 1 – 3	Acceptable
RMSEA	0.47	<0.06 = Excellent	Excellent
SRMR	0.07	<0.09 = Excellent	Excellent
GFI	0.87	>0.80 = Acceptable	Excellent
AGFI	0.83	>0.80 = Acceptable	Excellent
NFI	0.87	>0.80 = Acceptable	Excellent
TLI	0.91	>0.80 = Acceptable	Excellent
CFI	0.93	>0.80 = Acceptable	Excellent

Source: Author's Compilation

The value of all fit indices is acceptable. Hence, the model is considered fit, and further investigation can be performed.

Evaluation of Measurement Model:
Measurement models can be evaluated with convergent and divergent validity (Sarstedt, Ringle, and Hair (2021).

Convergent Validity:
Convergent validity refers to how different variables capture a familiar construct. To assess convergent validity, the average variance extracted (AVE) and composite reliability (CR) are the two widely used methods in business research (Mehta & Lad, 2024).

Table 4: Convergent Validity

Constructs	Cronbach's Alpha (Standardized)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Instructional Quality (IQ)	0.952	0.952	0.531
Use of Technology (UT)	0.690	0.690	0.428
Academic Intrinsic Motivation (AIM)	0.907	0.907	0.593
Student Engagement	0.951	0.951	0.668

Source: Author's Compilation

Table 4 exhibits the values of Cronbach's Alpha, composite reliability, and average covariance extracted. Sarstedt et al. (2021) recommended values above 0.70 and 0.50 as acceptable for composite reliability and AVE, respectively. From Table 4, it can be seen that all constructs met the standardized threshold values suggested by the previous researcher. Hence, it can be claimed that convergent validity has been achieved.

Discriminant Validity:
Discriminant validity is a test that will be performed to assess whether each construct is distinct from other constructs of the study or not (Chin, 1998; Hair et al., 2014). Fornell-Larcker scale and Heterotrait-Monotrait ratio are the two measures widely used across the research field to assess the discriminant validity of the constructs in the model (Salloum et al., 2019).
The Fornell-Larcker scale is based on the value of the average variance extracted. According to Salloum et al. (2019), the AVE for each construct in the correlation matrix must be greater than the correlation between latent constructs. Table 5 shows the values of the Fornell- Larcker Scale. All the values exhibited in the table met the threshold values, and it can be said that discriminant validity among the constructs presented in the current study model.

Table 5: Fornell-Larcker Scale

Constructs	AIM	IQ	SE	UT
AIM	0.770			
IQ	0.768	0.789		

SE	0.796	0.762	0.817	
UT	0.402	0.579	0.386	0.606

Source: Author's Compilation

The Hetrotrait-Monotrait (HTMT) ratio is another method used to check the discriminant validity of the research. Henseler et al. (2015) suggested an HTMT ratio approach widely used by the researcher to assess the DV. HTMT score should not exceed 0.85 (Clark & Watson, 1995) or 0.90 (Gold et al., 2001). Table 6 describes the values of the HTMT ratio, which is below the cutoff recommended by Henseler et al. (2015). Hence, it is now confirmed that each construct of the study measures the unique area of the subject.

Table 6: HTMT Ratio

Constructs	AIM	IQ	SE	UT
AIM				
IQ	0.798			
SE	0.820	0.768		
UT	0.442	0.572	0.400	

Source: Author's Compilation

Evaluation of Structural Model:

The structural model is assessed through the coefficient of determination (R^2), f-square. The result of the coefficient of determination presented in Table 7 showed a moderate R^2 for AIM (0.553) and SE (0.716). In contrast, R^2 for UT reported low (0.252). However, in social science, research is being carried out to predict behaviour that is subjective. However, if other explanatory variables of the study are significant, we can proceed with further analysis (Ozili, 2023).

Table 7: Coefficient of Determination (R^2)

Constructs	R-square	R-square adjusted
Academic Intrinsic Motivation	0.553	0.548
Student Engagement	0.716	0.712
Use of Technology	0.252	0.248

Source: Author's Compilation

Further, the result showed that instructional quality (f^2 = 0.904) significantly affects academic intrinsic motivation. At the same time, the use of technology has no significant effect on academic intrinsic motivation (f^2 = 0.000). Academic intrinsic motivation significantly affects student engagement (f^2 = 0.618).

Table 8: Path Coefficient Significance

H	Relationship	Path Coefficient Value	P Values	Results
H1	IQ → SE	0.393	0.05	Supported
H2	UT → SE	-0.058	0.63	Not Supported

* IQ – Instructional Quality, UT – Use of Technology, SE – Student Engagement, $p < 0.05$

The path coefficient was calculated using a bootstrapping procedure (5000 subsamples, one-tailed), and its result can be seen in Table 8. The result indicated that instructional quality ($\beta = 0.393$, $t = 1.924$, $p < 0.05$) significantly influences student engagement. While the use of technology ($\beta = -0.058$, $t = 0.470$, $p < 0.05$) does not influence student engagement.

Mediation Effect of Academic Intrinsic Motivation:

The Preacher and Hayes (2004) approach of indirect effect was used to test the mediation effect of academic intrinsic motivation between instructional quality, use of technology, and student engagement. The result of the indirect effect using a bootstrapping procedure (5000 subsamples, two-tailed) indicated that instructional quality indirectly affects student engagement via academic intrinsic motivation ($\beta = 0.574$, $t = 7.161$, $p < 0.05$). Hence, it can be said that academic intrinsic motivation mediates the relationship between instructional quality and student engagement. Furthermore, the indirect effect of the use of technology on student engagement via academic intrinsic motivation ($\beta = -0.046$, $t = 0.741$, $p < 0.05$) has no indirect effect, which indicates that academic intrinsic motivation does not mediate the relationship between the use of technology and student engagement.

Discussion:

The result of H1 is accepted. It is found that classroom process quality significantly influences student engagement. It is concluded that the instructional quality, connected in the classroom, is the strongest predictor of student engagement. These findings are consistent with the previous research (Decristan et al., 2015). The possible reason could be that the student's experience with teachers in the classroom will enhance their motivation and lead to increasing student engagement (Van Uden et al., 2014). An unexpected result derived from the study is that the use of technology does not influence student engagement. Hence, H2 is rejected. These results do not align with the previous research (Sung et al., 2016). The possible outcome may be attained because HEIs students' learning orientation will be to gain practical exposure to theoretical concepts and overcome their queries. Faculty expertise and experience are essential to providing the "human touch" that technology often lacks. While digital tools can enhance learning, they may not fully replace the mentorship, empathy, and nuanced understanding that educators bring to the classroom.

Finally, in hypothesis 3, the mediation results revealed that high academic intrinsic motivation contributes to high student engagement because internal motivation promotes learning among the students and forces them to focus in the classrooms. The result is consistent with the previous research stating that academic motivation indirectly influences student engagement (Fauth et al., 2019).

Limitations and Future Directions:

The present study is not free from limitations. Hence, it needs to be addressed for future research. First, the result of the study is based on the cross-sectional data. Thus, the inference from casual research cannot be drawn. A reciprocal relationship between variables may be possible. For example, an engaged student may be intrinsically motivated in their study, focus on the instruction delivered in the classroom, and use the technology to learn. Hence, future studies should adopt the longitudinal approach and consider the reciprocal relationship to validate the interrelationship between classroom process quality, academic intrinsic motivation, and student engagement. Second, the study has adopted a quantitative approach, which may have restricted the genuine response from the students. Hence, future studies should incorporate a mixed-method approach to gain qualitative findings. Student interviews can be conducted, which might give you detailed insights into students' perceptions of classroom quality. Lastly, the study adopted mediation analysis and did not adopt moderating analysis. Future research should include demographic characteristics such as age, gender,

and family income as moderators to determine the extent to which they contribute to the causal relationship between classroom process quality, academic intrinsic motivation, and student engagement.

Practical Implications:

Even after several studies on student engagement, what will lead to student engagement is still evolving. The present study offers empirical evidence regarding whether classroom quality or the use of technology influences student engagement. The mediation role of academic intrinsic motivation has also been explored to classroom process quality, use of technology, and student engagement. First, instructional quality positively influences student engagement, while the use of technology does not significantly influence student engagement. Second, academic intrinsic motivation has mediated the relationship between instructional quality and student engagement, while no mediation effect was observed between the use of technology and student engagement.

From the findings of the study, several theoretical implications can be drawn. First, it was the first study based on the instructional teaching framework developed by Klieme et al. (2009) to examine the relationship between classroom process quality and student engagement in Indian higher educational institutions.

The research also offers practical implications for higher educational institutions to foster student engagement. First, faculty members can be trained in designing classroom instructions and selecting pedagogy. Moreover, teachers should be given sufficient to develop the instruction and pedagogy for their respective subjects. Before they use it in the classroom, the experienced faculty should assess the quality of instructions developed by the faculty. Finally, cognitive activation and connectedness have been found to influence student engagement significantly. Hence, faculty should build a good rapport with the students to understand their expertise, knowledge level, and interest area, which ultimately will help the faculty decide classroom instructions.

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