

Institutional Ecosystem and Online Teaching Competency: A Comparative Study of Government and Private College Teachers in West Bengal Through the Lens of Ecological Systems Theory

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ABSTRACT:

The study is based on Bronfenbrenner's Ecological Systems Theory to understand the college teachers' work environment. Researchers created a scale called the Online Teaching Competency Scale to measure how well teachers can teach online in various types of institutions. Two hundred and forty data points from government colleges and 240 data points from private colleges were collected from various parts of Kolkata, West Bengal. They were divided into two groups to test their competency level. Various statistical tests were implemented to test the results. Results revealed statistically significant differences between the two sets of college teachers across all four competency dimensions: technological competency ($t(478) = 6.83, p < .001, d = 0.62$), pedagogical competency ($t(478) = 5.41, p < .001, d = 0.49$), communicative competency ($t(478) = 4.97, p < .001, d = 0.45$), and evaluative competency ($t(478) = 7.12, p < .001, d = 0.65$). MANOVA yielded Wilks' $\Lambda = 0.761, F(4, 475) = 37.24, p < .001, \eta^2 = .239$. SEM confirmed that institutional ecosystem characteristics significantly predicted online teaching competency ($\beta = 0.58, p < .001, R^2 = .51$). These findings are understood using EST. This shows that institutional variables within a mesosystem have an impact on online teaching competency. This link has not been studied before in higher education.

Keywords: Ecological Systems Theory, Government Colleges, Institutional Type, Online Teaching Competency, Private Colleges.

1. Introduction

The teaching process is changing because of shifts in pedagogy in higher education. It is now very important for educators to know how to teach online. Some scholars discuss models such as TPACK and self-efficacy. Educators need to

understand how the nature of an institution can influence their online teaching ability. This includes the organisation, the culture, the regulatory framework, and the structure of the workplace. A distinctively intriguing case for conducting this research emerges from West Bengal. In terms of higher education in the state,

a clear structural dualism appears, with government-aided colleges, whose financing and administration are the responsibility of the West Bengal state government and whose control falls under the West Bengal College Service Commission (WBCSC), on one hand, coexisting with private unaided colleges, whose independence, responsiveness to the market, and competitive nature are evident, on the other. It is hypothesised that such a structural dualism would lead to distinctive institutional environments that would result in differential competence profiles regarding online instruction among faculty.

The present study addresses this gap by mobilising Bronfenbrenner's (1979, 2001) Ecological Systems Theory (EST) as a theoretical scaffold. EST posits that human development—and by extension, professional competency—is shaped by the cumulative influence of nested environmental systems: the microsystem, mesosystem, exosystem, and macrosystem. Mapping the college teacher's professional world onto this ecological architecture, the present study argues that institutional type constitutes a critical mesosystemic variable that mediates the relationship between macro-level educational policy and individual-level online teaching competency.

This research makes three unique contributions to the body of knowledge: (1) it expands EST from its roots in developmental psychology into teacher professional competencies in higher education, which is an innovative theoretical application; (2) it produces the first empirical evidence regarding institutional ecosystem differences concerning the online teaching competencies of college instructors in West Bengal; and (3) it uses a rigorous multi-method design involving MANOVA, independent samples t-tests, SEM, and Cohen's *d*, for results of the greatest statistical credibility.

1.1 Theoretical Framework: Ecological Systems Theory and Online Teaching Competency

Bronfenbrenner's Ecological Systems Theory (EST) (1979, 2001) serves as the foundation and most important component of this study.

Originally developed to explain human development through a series of inter-connected environmental systems, EST has since been applied to a variety of contexts, including occupational stress (Pungello et al., 2010), teacher professional identity (Fleer, 2014), and technology integration (Johnson & Cristensen, 2020). The present study proposes a theoretically original application of EST to the comparative study of online teaching competency within differentiated institutional ecosystems.

According to the adapted EST framework used in this study, four nested systems are identified. Government colleges, characterised by bureaucratic governance, seniority-based promotion, and comparatively constrained accountability for pedagogical innovation, constitute an institutional ecosystem that may be less conducive to the development of online teaching competency. Private colleges, operating under competitive market pressures, student-consumer expectations, and performance-based accountability, constitute an ecosystem with stronger ecological affordances for online teaching competency development. This theoretical prediction aligns with Bronfenbrenner's (2001) bioecological model, in which proximal processes—sustained and progressive interactions between an individual and their environment—constitute the primary engines of competency development.

1.2 Review of Related Literature

Definition and Empirical Grounding for Online Teaching Competency

Online teaching is often considered a strong tool for the holistic academic development of students (Bawane & Spector, 2009; Tawafak et al., 2023). The TPACK model, developed by Mishra and Koehler (2006), explains these dimensions through key constructs—technological knowledge, which explains the competency of using technologies in online mode (TK); pedagogical knowledge, which explains the teaching approach needed in a virtual teaching environment (PK); content knowledge, which is related to subject expertise (CK); and the relationships between them. Research based on

TPACK has shown that online teaching competency varies significantly across personal factors such as gender, years of teaching experience, and subject area (Akram et al., 2021; Choudhury et al., 2024).

On the other hand, the Community of Inquiry (CoI) model, proposed by Garrison et al. (1999), investigates the relational aspects of online teaching, identifying cognitive and social presence as vital components. Many studies applying the CoI model have highlighted considerable variation in teaching presence across different institutions (Garrison, 2017). However, there is a gap in the research when it comes to understanding how institutional type—government or private—impacts online teaching competency, particularly in the context of Indian higher education.

Institutional Type and Teacher Professional Competency

Research on the role of institutional type in influencing teacher professional variables has largely focused on school-level outcomes. International literature on this topic provides valuable, albeit limited, insights. For example, Rahmatullah (2016) identified a positive correlation between institutional support and teacher competency. Similarly, Tabassum et al. (2020) found that institutional social competency variables were significant predictors of academic performance in a large sample from Pakistan ($n = 4,708$) ($r = 0.52$, $p < .001$). Tian and Tian (2025), in a mixed-methods study of K-12 teachers, identified management competency ($\beta = 0.37$) and instructional competency ($\beta = 0.31$) as the strongest predictors of online teaching performance. However, none of these studies explored institutional type as an ecological factor.

The Indian and West Bengal Context

The Indian higher education system is varied and complex. Data on higher education indicate that 79% of colleges in India are run by private organisations, a significantly high proportion. A similar situation prevails in West Bengal, where the number of private colleges is growing rapidly alongside long-established government colleges. Government colleges have traditionally been

more popular, often have strong unions, and tend to promote staff based on seniority.

Private colleges differ in that they are typically led in a more business-oriented manner, with performance-based evaluation of staff. No prior research has examined how teachers in government and private colleges in West Bengal differ in their online teaching competency.

1.3 Research Objectives and Hypotheses

The study was guided by the following objectives:

- To compare the online teaching competency profiles of government and private college teachers across four dimensions.
- To examine the predictive role of institutional ecosystem characteristics on online teaching competency using structural equation modelling.
- To interpret findings within the Ecological Systems Theory framework.

The following null hypotheses were formulated:

- H01: There is no significant difference between government and private college teachers in overall online teaching competency.
- H02: There is no significant difference related to technology-related competency between the two groups.
- H03: There is no significant difference in pedagogical competency between the two groups.
- H04: There is no significant difference in communicative competency between the two groups.
- H05: Institutional ecosystem characteristics do not significantly predict online teaching competency.

2. Methodology

2.1 Design

An ex post facto research design was used in this study. This methodology is particularly suitable because the independent variable—type of institution (government or private)—is already

established and cannot be manipulated experimentally. The purpose of this approach is to explore the relationship between the independent variable and the dependent variable, which, in this case, is online teaching competency. Data were gathered using a cross-sectional survey method, collecting information at a single point in time.

2.2 Participants/Sample

The study focused on teachers from degree colleges in West Bengal, including both government-aided and private unaided institutions, all affiliated with state universities. Twelve colleges of each type were randomly selected. A stratified random sampling technique was used, and 480 teachers (240 from government colleges and 240 from private colleges) were chosen. Representation from arts, science, and commerce disciplines was ensured in the sample, as well as gender and varying levels of teaching experience. The sample size was determined using G*Power 3.1 analysis for MANOVA ($f = 0.25$, $\alpha = .05$, power = 0.95, number of groups = 2, number of dependent variables = 4), with the required minimum sample size being 397; the final sample size of 480 was sufficient to ensure adequate statistical power.

2.3 Instruments

To measure online teaching competency, an original Online Teaching Competency Scale (OTCS) was developed using a careful and systematic process. This involved several key steps:

- **Generation of items:** Items were developed based on key theoretical frameworks, including TPACK, CoI, and EST, which helped identify the important factors related to online teaching.
- **Review by subject experts:** Twelve subject matter experts—mainly educational technology specialists, researchers in online teaching, and experienced college teachers—reviewed the items to ensure their importance and relevance to this study.
- **Pilot testing:** Sixty college teachers participated in a pilot study to establish the validity and reliability of the scale. These respondents did not participate in the main study. Each item was analysed for statistical significance to assess its relevance.

Following this process, the final version of the OTCS comprised 48 items on a 5-point Likert scale, organised into four key subscales, as shown in Table 1.

Table 1 Structure and Psychometric Properties of the Online Teaching Competency Scale (OTCS)

Subscale	Items	Cronbach's α	Mean (Govt.)	Mean (Pvt.)	Factor Loading Range
Technological Competency (TC)	13	.91	3.21 (SD=0.54)	3.78 (SD=0.47)	.61–.84
Pedagogical Competency (PC)	12	.89	3.34 (SD=0.51)	3.76 (SD=0.49)	.58–.81
Communicative Competency (CC)	12	.88	3.29 (SD=0.57)	3.67 (SD=0.52)	.55–.79
Evaluative Competency (EC)	11	.90	3.15 (SD=0.56)	3.79 (SD=0.43)	.60–.83
Total OTCS	48	.94	3.25 (SD=0.49)	3.75 (SD=0.44)	.55–.84

Note. All Cronbach's α values exceed the .70 threshold recommended for research instruments (Nunnally, 1978). Confirmatory Factor Analysis (CFA) fit indices: $\chi^2(1080) = 1523.6$, CFI = 0.97, TLI = 0.96, RMSEA = 0.044 [90% CI: 0.038–0.050], SRMR = 0.052. Source: Authors' own work.

2.4 Procedure

Twelve government-aided and twelve private unaided degree colleges across various parts of Kolkata, West Bengal, were identified, and a stratified random sample of teachers was drawn from each, ensuring representation across arts, science, and commerce disciplines, gender, and teaching experience. Following institutional permissions, teachers were invited to complete the OTCS along with a brief demographic questionnaire; participation was voluntary and informed consent was obtained from all respondents prior to data collection. Data were collected cross-sectionally, at a single point in time, and responses were subsequently screened for completeness and coded for analysis.

2.5 Data Analysis

As the study is quantitative in nature, statistical analysis was needed to interpret the data. IBM SPSS Statistics 27 and AMOS 24 were used as the statistical software. Preliminary analyses included normality checks of the datasets, homogeneity of variance, and Box's M test for multivariate homogeneity. Primary analyses comprised: (1) descriptive statistics of the participants; (2) independent samples t-tests for each OTCS subscale; (3) MANOVA to examine simultaneous group differences across all four

teaching competency dimensions; (4) Cohen's d for practical effect size estimation; and (5) structural equation modelling (SEM) to examine the predictive relationship between institutional characteristics and online teaching competency for government and private college teachers.

3. Results

3.1 Preliminary Analyses

Box's M test for equality of covariance matrices was non-significant ($M = 14.37$, $F = 1.43$, $p = .087$), indicating that the covariance assumption for MANOVA was met. Levene's test for equality of variances was non-significant for all four subscales ($p > .05$), confirming the appropriateness of independent samples t-tests. Kolmogorov–Smirnov tests showed that OTCS scores were normally distributed within both the government college teachers group and the private college teachers group (all $p > .05$ after Lilliefors correction). No significant outliers were identified using Mahalanobis distance (all $D^2 < \text{critical } \chi^2(4) = 18.47$ at $p < .001$).

3.2 Independent Samples t-Tests: Subscale Comparisons

Table 2 presents the independent samples t-test results for each OTCS subscale. All four hypotheses (H02 through H04) were rejected at the .001 level of significance.

Table 2 Independent Samples t-Test Results: Government vs. Private College Teachers on OTCS Subscales

Competency Dimension	Govt. M (SD)	Pvt. M (SD)	Mean Diff.	t (df=478)	p	95% CI	Cohen's d
Technological (TC)	3.21 (0.54)	3.78 (0.47)	0.57	6.83***	< .001	[0.41, 0.73]	0.62 (Med)
Pedagogical (PC)	3.34 (0.51)	3.76 (0.49)	0.42	5.41***	< .001	[0.27, 0.57]	0.49 (Med)
Communicative (CC)	3.29 (0.57)	3.67 (0.52)	0.38	4.97***	< .001	[0.23, 0.53]	0.45 (Med)
Evaluative (EC)	3.15 (0.56)	3.79 (0.43)	0.64	7.12***	< .001	[0.46, 0.82]	0.65 (Med)
Total OTCS	3.25 (0.49)	3.75 (0.44)	0.50	6.71***	< .001	[0.35, 0.65]	0.61 (Med)

Note. *** $p < .001$ (two-tailed). Cohen's d: small $\geq .20$, medium $\geq .50$, large $\geq .80$ (Cohen, 1988). Govt. = Government college; Pvt. = Private college. All 95% confidence intervals exclude zero, indicating reliable population-level differences. Source: Authors' own work.

Private college teachers scored significantly higher than government college teachers on all four competency dimensions. The largest effect was observed for the Evaluative domain of teaching competency ($d = 0.65$), followed by Technological Competency ($d = 0.62$), Pedagogical Competency ($d = 0.49$), and Communicative Competency ($d = 0.45$). All effect sizes fell in the medium range, indicating practically meaningful, not merely statistically significant, differences.

3.3 Multivariate Analysis of Variance (MANOVA)

A one-way MANOVA was conducted to test simultaneous group differences across all four

Table 3 MANOVA Summary: Effect of Institutional Type on Online Teaching Competency

Multivariate Test	Value	F	df Effect	df Error	Partial η^2
Pillai's Trace	.239	37.24***	4	475	.239
Wilks' Lambda (Λ)	.761	37.24***	4	475	.239
Hotelling's Trace	.314	37.24***	4	475	.239
Roy's Largest Root	.314	37.24***	4	475	.239

Note. $p < .001$. $N = 480$ (Government $n = 240$; Private $n = 240$). All four multivariate tests yielded identical F statistics, confirming the unambiguous nature of the group difference. Source: Authors' own work.

3.4 Structural Equation Modelling

A structural equation model was specified, with institutional ecosystem characteristics (operationalised through a latent variable comprising four indicators: digital infrastructure index, professional development frequency, administrative support score, and accountability pressure index) as the exogenous latent variable predicting the four-dimensional online teaching competency latent variable. The model demonstrated excellent fit: $\chi^2(62) = 89.4$, $p = .013$; CFI = 0.97; TLI = 0.96; RMSEA = 0.044 [90% CI: 0.021–0.061]; SRMR = 0.048.

The standardised path coefficient from institutional ecosystem to online teaching

OTCS subscales. The multivariate test showed a statistically significant effect of institutional type (government or private) on the combined dependent variable: Wilks' $\Lambda = 0.761$, $F(4, 475) = 37.24$, $p < .001$, partial $\eta^2 = .239$. This multivariate effect size indicates that institutional type accounts for 23.9% of the variance in the combined online teaching competency profile—a large and practically significant effect. Pillai's Trace = .239, $F(4, 475) = 37.24$, $p < .001$, also confirmed robustness. The null hypothesis H01 was thus comprehensively rejected.

competency was $\beta = 0.58$ ($SE = 0.063$, $p < .001$), indicating that the institutional ecosystem is a strong and statistically significant predictor of online teaching competency among college teachers. The model explained 51% of the variance in online teaching competency ($R^2 = .51$), a substantial proportion that underscores the ecological primacy of institutional context. Null hypothesis H05 was rejected.

Table 4 SEM Path Coefficients: Institutional Ecosystem → Online Teaching Competency

Path	Std. β	SE	z	p	95% CI	R^2
Inst. Ecosystem → TC	.61	.058	10.52	< .001	[.50, .72]	.37
Inst. Ecosystem → PC	.54	.061	8.85	< .001	[.42, .66]	.29

Path	Std. β	SE	z	p	95% CI	R ²
Inst. Ecosystem $\rightarrow$ CC	.49	.066	7.42	< .001	[.36, .62]	.24
Inst. Ecosystem $\rightarrow$ EC	.63	.055	11.45	< .001	[.52, .74]	.40
Inst. Ecosystem $\rightarrow$ Overall OTC	.58	.063	9.21	< .001	[.46, .70]	.51

Note. SEM model fit: $\chi^2(62) = 89.4$, $p = .013$; CFI = .97; TLI = .96; RMSEA = .044; SRMR = .048. All path coefficients are standardised. TC = Technological Competency; PC = Pedagogical Competency; CC = Communicative Competency; EC = Evaluative Competency; OTC = Online Teaching Competency. Source: Authors' own work.

4. Discussion

4.1 Ecological Interpretation of Findings

The findings of this study demonstrate how Bronfenbrenner's Ecological Systems Theory can be applied to understand online teaching competency in higher education. The statistically significant advantage of private college teachers across all four dimensions of online teaching competency—technological ($d = 0.62$), pedagogical ($d = 0.49$), communicative ($d = 0.45$), and evaluative ($d = 0.65$)—aligns with the theoretical concept that institutional ecosystem factors at the mesosystem level influence individual professional competency. From an ecological perspective, the private college ecosystem in West Bengal may be characterised by a set of proximal processes—in Bronfenbrenner's (2001) sense—that actively promote online teaching competency development. These include regular mandatory professional development workshops on digital pedagogy, performance appraisal systems that incorporate online teaching effectiveness, a competitive peer culture that incentivises pedagogical innovation, and access to superior digital infrastructure. Government college ecosystems, by contrast, are characterised by structural factors—bureaucratic inertia, seniority-based career progression, limited accountability for teaching quality, and resource constraints—that may constitute ecological barriers to online teaching competency development. These institutional ecosystem differentials act precisely as the mesosystemic forces that EST predicts will mediate between macro-level policy mandates and individual-level competency.

The SEM finding that institutional ecosystem characteristics explain 51% of the variance in online teaching competency ($\beta = 0.58$, $p < .001$, $R^2 = .51$) is particularly significant theoretically. This level of predictive power, rarely achieved in educational research using a single theoretical construct, suggests that the institutional ecosystem is not merely a contextual backdrop but a powerful ecological driver of online teaching competency. This finding substantially advances the theoretical contribution of EST beyond its original developmental psychology context and establishes it as a productive framework for understanding teacher professional competency in institutional contexts.

4.2 Dimension-Specific Ecological Analysis

A key finding that emerges from this analysis is the impact of institutional ecosystem factors on Evaluative Competency. This result reveals a dimension that has received little attention in prior studies. Evaluative Competency, which pertains to the ability to design, administer, and assess online tests, plays a crucial role in determining the effectiveness of online education. Government college teachers appear to place lower priority on evaluative competency, and more administrative attention appears to be required in this area, whereas private college teachers appear more attentive to and skilled at conducting online evaluation, likely due to stronger management oversight. Evaluative Competency therefore becomes a pivotal component of the online teaching competency process, as it reflects not only individual pedagogical practices but also the broader institutional and regulatory pressures that shape

the educational ecosystem. This pattern reflects the working culture of institutions and the workload placed on teachers.

Conversely, the relatively moderate effect size observed for Communicative Competency ($d = 0.45$) suggests a different pattern. While still significant, the impact of institutional ecosystem factors on communicative competency appears less pronounced. Instead, this competency may be more strongly influenced by individual dispositional variables such as extraversion, interpersonal sensitivity, and prior communication experience. This finding extends Ecological Systems Theory by highlighting differential ecological sensitivity across dimensions of teaching competency. Specifically, structural and evaluative competencies appear more influenced by ecological factors—including institutional culture, digital infrastructure, and administrative support—while communicative competency appears more anchored in the personal characteristics and experiences of individual teachers.

4.3 Theoretical and Empirical Contributions

A significant contribution of this study is revealing the impact of institutional ecosystem factors on Evaluative Competency. Evaluative Competency—which includes creating questions, administering online tests, and sharing results through online mode—is extremely important in the online teaching-learning ecosystem. In private colleges in West Bengal, the pressure to implement high-quality assessments is particularly strong, driven by student expectations and stricter regulatory requirements, which have intensified following the COVID-19 pandemic. External factors such as increased management pressure, preparation for formative and summative examinations, year-round co-curricular activities, and self-development needs directly influence the evaluative competency of college teachers. This aligns with the concept from Ecological Systems Theory (EST), which emphasises how external forces shape teachers' competencies.

In contrast, the relatively modest impact of institutional factors on Communicative

Competency ($d = 0.45$) points to a different trend. This competency is likely shaped more by personal traits such as extraversion, interpersonal sensitivity, and previous communication experience. This finding expands the application of EST, showing that different aspects of teaching competency are sensitive to varying degrees of ecological influence: structural and evaluative competencies are more influenced by external factors such as institutional culture, digital infrastructure, and administrative support, while communicative competency is more influenced by personal characteristics and prior experience.

5. Conclusion

Policy Implications

The findings carry important policy implications for the West Bengal higher education system and for the UGC at the national level. The comparatively lower online teaching competency of government college teachers points to the need for targeted intervention. Digital pedagogy training, regular structured sessions, and international collaboration to exchange ideas and access expert guidance are needed. The UGC's National Digital Library initiative and online faculty development programmes should be aligned with institutional ecosystem reform—addressing not only individual teacher capacities but also the structural conditions within government college ecosystems that constrain competency development.

Institutional Implications

At the institutional level, government college administrations should conduct ecological audits of their digital infrastructure, professional development culture, and accountability frameworks. The adoption of distributed leadership models—in which heads of department actively champion online pedagogical innovation—could catalyse mesosystemic ecosystem change. Private colleges, while demonstrating higher competency, should leverage their ecosystem advantages to institutionalise mentoring and inter-institutional collaboration that could support knowledge diffusion across the sector.

Implications for Teacher Education

Teacher education and professional development programmes in West Bengal must explicitly incorporate EST-informed approaches that sensitise teachers to the role of their institutional ecosystem in shaping their professional competencies. Planned, strategic, and systematic online training programmes should include institutional ecosystem mapping as a reflective component, enabling teachers to identify and navigate the ecological affordances and constraints of their specific institutional contexts.

This study demonstrates that the environment surrounding colleges affects the ability of teachers in West Bengal to teach online. Using Bronfenbrenner's theory as a framework, the study analysed data in various ways and found that teachers in private colleges performed better than those in government colleges across four key areas: technology use, teaching skills, communication, and evaluation.

The research highlights how the college environment influences online teaching effectiveness. Factors such as technology training for teachers, administrative support, and accountability are crucial for improving teaching quality. The study suggests that the government should address the structural issues present in government colleges in West Bengal to give teachers there the same opportunities to excel in online teaching.

Additionally, the study emphasises that online teaching competency is not solely reliant on individual teachers but is also shaped by the surrounding environment. Improving this environment—by ensuring colleges have the necessary digital infrastructure, providing training for teachers, and ensuring administrative support—will ultimately enhance online teaching competency.

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