PREFACE TO THE EDITION

The **International Journal of Teacher Education Research Studies (IJTERS)** is pleased to present this issue, which brings together significant scholarship addressing the evolving realities of teacher education, school systems, and learner wellbeing.

The contributions in this volume explore education from multiple vantage points psychological, institutional, technological, and policy-driven. The opening study highlights the transformative potential of Transactional Analysis–based group training in nurturing self-esteem among college students, reminding us that teacher education must remain deeply connected to the emotional and psychological health of learners.

Several papers examine one of the most urgent challenges facing education today teacher retention and attrition in government schools. Through large-scale trend analyses and mixed-methods investigations, these studies unpack structural shortages, workplace stress, compensation inequities, and systemic deployment issues, offering evidence-based pathways for reform aligned with contemporary policy frameworks.

Another critical strand in this issue investigates digital readiness and technological competence in schools and teacher preparation programs. Research on digital infrastructure inequality reveals stark contrasts between urban private and rural government schools, while the meta-synthesis on digital pedagogical competencies among pre-service teachers highlights both progress and persistent gaps in meaningful technology integration.

Taken together, these articles illuminate the complex ecosystem in which teachers work shaped by policy, infrastructure, technology, wellbeing, and professional identity. They call for thoughtful reforms grounded in research, compassion, and collaboration.

We extend our sincere appreciation to the authors, reviewers, and readers who contribute to strengthening scholarly dialogue in teacher education. It is our hope that the insights presented in this issue inspire continued inquiry, informed practice, and renewed commitment to building equitable and resilient educational systems.

Dr. Premachandran P

Chief Editor

CONTENTS

Enhancing Self-Esteem through Transactional Analysis Group Training among College Students in Kerala

Latha Sreekumar[1], Rekha K.S[2]

[1]Research Scholar, Department of Psychology, Bir Tikendrajit University, Manipur, India.

[2]Research Supervisor, Department of Psychology, Bir Tikendrajit University, Manipur, India

Abstract

Background: The manner in which individuals perceive and evaluate their own worth constitutes a fundamental determinant of mental wellness and scholastic achievement among university learners. Within Kerala's educational landscape, characterized by heightened academic rivalry, numerous students grapple with diminished self-regard. The Transactional Analysis (TA) theoretical model presents a viable approach for bolstering self-worth by fostering enhanced personal insight and relational effectiveness.

Objective: The present investigation sought to examine the influence of a TA-grounded group intervention program on self-regard among undergraduate learners in Kerala, India.

Method: A quasi-experimental methodology incorporating baseline and post-intervention assessments with a comparison group was implemented. Eighty undergraduate learners from liberal arts and science institutions in Kerala were allocated to either a treatment condition ($n = 40$) or a comparison condition ($n = 40$). Treatment recipients engaged in eight TA-based group sessions lasting 90 minutes each, convened biweekly across a four-week duration. Self-regard was quantified utilizing the Rosenberg Self-Esteem Scale (RSES).

Results: ANCOVA findings revealed statistically meaningful between-group disparities at the post-intervention assessment, $F(1, 77) = 45.67$, $p < .001$, partial $\eta^2 = .37$. The treatment group exhibited marked enhancement in self-regard indices (baseline $M = 18.45$, $SD = 4.32$; post-intervention $M = 26.78$, $SD = 3.89$), whereas the comparison group manifested negligible variation (baseline $M = 18.12$, $SD = 4.56$; post-intervention $M = 18.89$, $SD = 4.23$).

Conclusion: These outcomes furnish robust substantiation for the efficacy of TA group programming in augmenting self-worth among Kerala's collegiate population. Such findings carry significant ramifications for psychological counseling provisions and wellness initiatives within academic establishments throughout the region.

Keywords: - Transactional Analysis, Self-Esteem, College Students, Group Intervention, Kerala.

I. INTRODUCTION

Self-regard, characterized as a person's holistic subjective appraisal of their intrinsic value (Rosenberg, 1965), stands among the most thoroughly examined psychological phenomena. Empirical evidence consistently indicates that robust self-worth correlates with diverse favorable outcomes encompassing scholastic success, mental wellness, and effective social bonds (Orth & Robins, 2014). In contrast, deficient self-regard has demonstrated associations with depressive symptomatology, anxious states, problematic substance use, and numerous additional psychological challenges (Sowislo & Orth, 2013).

The undergraduate phase constitutes a pivotal developmental juncture wherein self-worth may prove especially susceptible. Learners encounter myriad obstacles including scholarly demands, self-exploration, interpersonal connections, and vocational choices (Arnett, 2015). Within Kerala's context, these difficulties are frequently intensified by the intensely competitive scholastic milieu, familial anticipations, and cultural pressures endemic to the state's academic infrastructure.

Kerala's prioritization of educational excellence, while yielding elevated literacy statistics and academic accomplishments, simultaneously generates considerable psychological strain on learners (Soman, 2018).

Investigations undertaken in Kerala have chronicled troubling degrees of psychological anguish among university learners. Findings from (Nair et al., 2020) indicated that a substantial segment of collegiate students within the state exhibited anxiety and depressive manifestations, with compromised self-regard recognized as a contributory element. Kerala's distinctive sociocultural milieu, encompassing its matrilineal customs in particular communities, accelerated modernization processes, and extensive migratory patterns, engenders an intricate setting that may influence student self-perception (Kurien, 2021).

Transactional Analysis (TA), formulated by psychiatrist Eric Berne during the late 1950s, furnishes an encompassing theoretical scaffold for comprehending personality architecture, interpersonal exchanges, and psychological transformation (Berne, 1961). Foundational to TA doctrine is the notion of ego states, representing discrete configurations of cognition, affect, and conduct. Berne delineated three cardinal ego states: Parent, Adult, and Child. The Parent ego state encompasses orientations, principles, and comportments assimilated from parental figures. The Adult ego state embodies logical, reality-grounded processing. The Child ego state incorporates affective responses and developmentally acquired behavioral patterns.

TA doctrine posits that self-regard maintains intimate connections with life position constructs, which represent foundational convictions regarding oneself and others established during early development (Harris, 1969). The four life orientations comprise: I'm OK, You're OK (adaptive stance); I'm OK, You're Not OK (externalized stance); I'm Not OK, You're OK (internalized stance, correlated with diminished self-worth); and I'm Not OK, You're Not OK (hopelessness stance). Via TA-based interventions, persons can attain consciousness of their life orientation and progress toward embracing the healthful I'm OK, You're OK position.

Scholarly inquiry has yielded substantiation for the utility of TA interventions in augmenting psychological wellness. (Torkaman et al., 2020) executed a controlled investigation revealing that TA group treatment substantially elevated self-regard among individuals diagnosed with major depressive disorder. (Vos & van Rijn ,2022) disseminated a comprehensive synthesis and quantitative integration discovering support for TA treatment efficacy spanning diverse clinical manifestations. Research within academic contexts has yielded encouraging outcomes for TA-grounded approaches with learner populations (Sundah, 2018).

1.1. Objectives of the Study

The central aims guiding this investigation were:

- To gauge self-worth levels among Kerala's collegiate learners preceding and succeeding Transactional Analysis group programming.
- To appraise the efficacy of Transactional Analysis group programming in bolstering self-regard among Kerala's university students.

1.2. Hypotheses

- H1: Statistically meaningful disparities in self-regard indices will emerge between collegiate learners receiving TA group programming and those comprising the comparison condition.
- H2: University students engaging in TA group programming will exhibit meaningfully elevated self-worth scores at post-intervention relative to baseline.

II. REVIEW OF LITERATURE

2.1. Self-Esteem in College Students

Self-regard has been theorized through diverse perspectives across psychology's evolution. (Rosenberg, 1965) characterized self-esteem as a favorable or unfavorable orientation toward oneself, integrating both evaluative and emotional dimensions. This theoretical formulation has steered considerable ensuing scholarly work within the domain. Present-day investigators broadly concur that self-worth mirrors an individual's comprehensive perception of personal merit and intrinsic value (Orth & Robins, 2014).

Scholarly inquiry has persistently affirmed self-regard's significance for psychological adjustment. Quantitative synthesis investigations have established that compromised self-worth correlates with depressive states (Sowislo & Orth, 2013), anxious symptomatology, and diminished life fulfillment. Prospective research intimates that deficient self-regard may function as a susceptibility element for psychological difficulties' emergence (Orth et al., 2016). Alternatively, robust self-esteem demonstrates links to heightened resilience, superior adaptive capacities, and enhanced scholastic outcomes.

Investigations within India's milieu have illuminated distinctive elements shaping self-worth among collegiate learners. (Deb et al., 2015) ascertained that scholastic demands, parental anticipations, and peer dynamics substantially influenced Indian students' self-regard. Specifically within Kerala, studies have chronicled the psychological ramifications of the state's intensely competitive academic atmosphere. The focus on scholarly attainment, while generating commendable educational outcomes, has shown associations with heightened stress and anxiety levels among students (Thomas & Raj, 2019).

2.2. Transactional Analysis: Theoretical Framework

Transactional Analysis materialized during the 1950s via Eric Berne's endeavors, who aspired to construct an approachable methodology for grasping human conduct and enabling psychological transformation (Berne, 1961). TA synthesizes psychodynamic notions with humanistic tenets, providing both a personality framework and a modality for

therapeutic engagement. The ego state paradigm constitutes TA theory's cornerstone, with each ego state-Parent, Adult, and Child-embodying an integrated configuration of cognitions, emotions, and actions.

The stroke notion occupies centrality in comprehending self-regard through a TA lens. Strokes represent acknowledgment units, and (Berne, 1972) advanced that humans harbor an essential requirement for strokes comparable to biological necessities for nourishment and protection. Life scripts, an additional pivotal TA construct, represent subconscious life blueprints formulated during childhood that shape an individual's self-perception and life course (Berne, 1972).

2.3. Effectiveness of TA Interventions

Scholarship probing TA intervention efficacy has accrued across multiple decades. (Vos & van Rijn, 2022) undertook a comprehensive synthesis scrutinizing TA treatment effectiveness spanning diverse clinical presentations. (Torkaman et al., 2020) disseminated a controlled investigation in BMC Psychology scrutinizing TA group treatment's influence on self-regard among patients with major depressive disorder. (Sundah, 2018) explored TA group counseling's influence on self-regard among secondary learners, discovering meaningful improvements within the treatment cohort.

III. METHOD

3.1. Research Design

The present investigation utilized a quasi-experimental methodology incorporating baseline and post-intervention measurements with a comparison cohort. The predictor variable comprised group classification (treatment versus comparison), while the criterion variable was self-regard as quantified by the Rosenberg Self-Esteem Scale.

3.2. Participants

Study participants comprised 80 undergraduate learners enlisted from two liberal arts and science institutions affiliated with the University of Kerala in Thiruvananthapuram district. Eligibility requirements encompassed:

- Registration as a full-time undergraduate learner
- Chronological age spanning 18 to 25 years
- Low to moderate self-worth as denoted by a rosenberg self-esteem scale value beneath 25
- Provision of informed assent.

Table 1. Demographic Characteristics of Participants (N = 80)

Variable	Experimental (n=40)	Control (n=40)
Male	16 (40.0%)	15 (37.5%)
Female	24 (60.0%)	25 (62.5%)
Age M (SD)	20.35 (1.42)	20.18 (1.56)

3.3. Instruments

Rosenberg Self-Esteem Scale (RSES). The RSES (Rosenberg, 1965) constitutes a broadly employed 10-item self-assessment instrument gauging global self-regard. Responses utilize a 4-point Likert format spanning 1 (strongly disagree) to 4 (strongly agree), yielding aggregate scores between 10 and 40. Within the current investigation, Cronbach's alpha reached .85 at baseline and .88 at post-intervention.

3.4. Intervention

The TA group programming intervention encompassed eight 90-minute gatherings convened biweekly across four weeks. Sessions were directed by a credentialed Transactional Analyst possessing expertise in academic contexts and familiarity with Kerala's milieu.

3.5. Procedure

Institutional ethics authorization was secured from the review committee preceding data gathering. Learners satisfying eligibility specifications were allocated to treatment or comparison conditions predicated on institutional enrollment to curtail cross-contamination between cohorts.

3.6. Data Analysis

Quantitative analyses were executed utilizing SPSS version 26.0. The principal hypothesis underwent examination employing analysis of covariance (ANCOVA) with post-intervention self-regard scores as the criterion variable, cohort as the predictor variable, and baseline scores as the covariate.

III. RESULTS

3.1. Preliminary Analyses

Initial analyses scrutinized baseline comparability between cohorts. Independent samples t-tests disclosed no meaningful disparities between treatment and comparison cohorts on baseline RSES values, $t(78) = 0.34$, $p = .735$. ANCOVA prerequisites were evaluated and satisfied.

3.2. Descriptive Statistics

Table 2 displays summary statistics for self-regard indices organized by cohort and assessment occasion. The treatment cohort manifested considerable enhancement in average self-worth values from baseline to post-intervention, while the comparison cohort exhibited negligible variation.

Table 2. Descriptive Statistics for Self-Esteem Scores by Group and Time

Time Point	Exp M	Exp SD	Ctrl M	Ctrl SD
Pretest	18.45	4.32	18.12	4.56
Posttest	26.78	3.89	18.89	4.23
Change	8.33	2.87	0.77	1.98

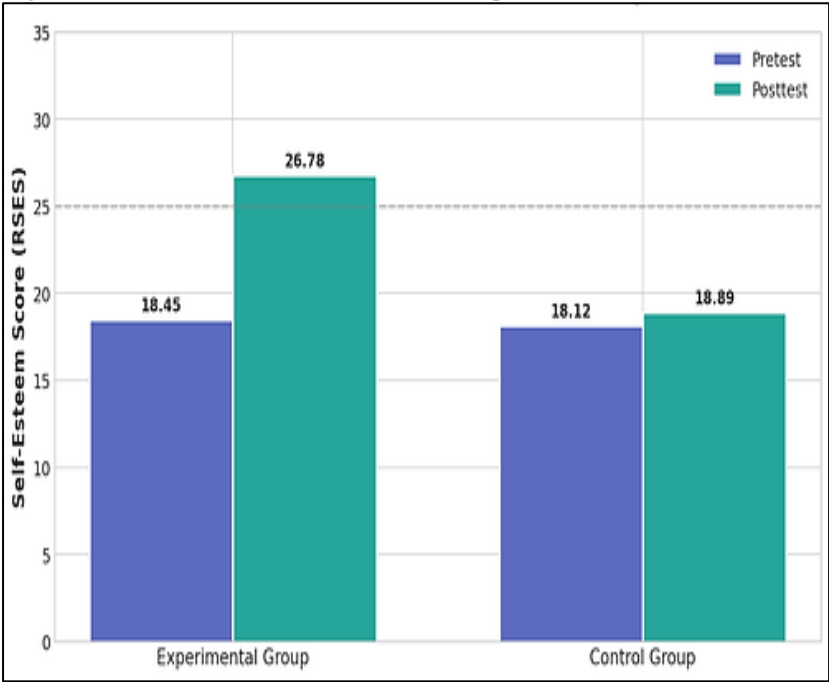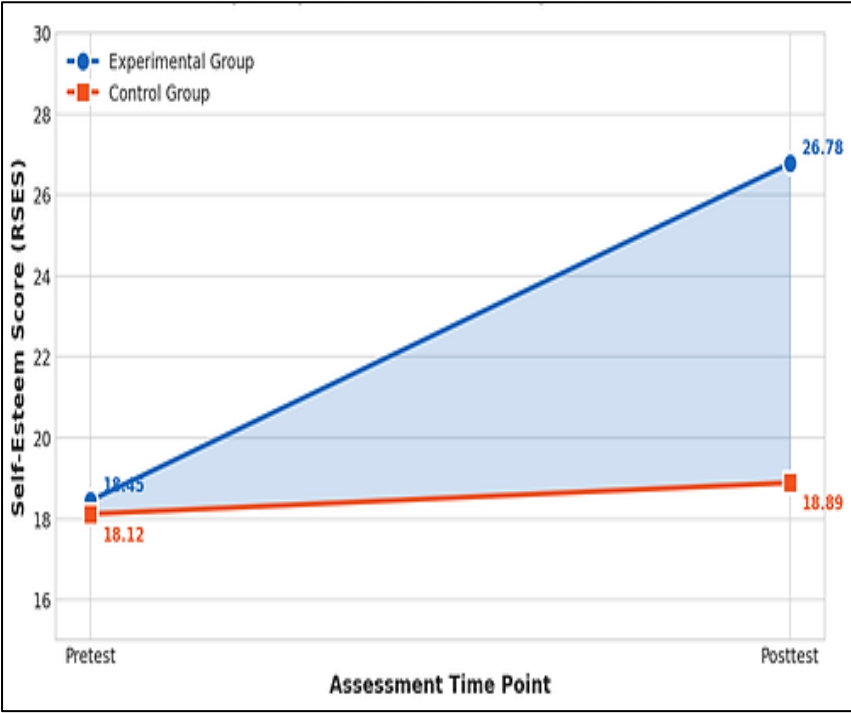Fig 1: Self-Esteem Scores: Pretest vs Posttest Comparison

Fig 2: Trajectory of Self-Esteem Change Over Time

3.3. Hypothesis Testing

ANCOVA was implemented to evaluate the principal hypothesis. Findings disclosed a statistically meaningful cohort effect on post-intervention self-regard indices following adjustment for baseline values, $F(1, 77) = 45.67$, $p < .001$, partial $\eta^2 = .37$. Per (Cohen, 1988) benchmarks, this denotes a substantial effect magnitude.

Table 3. ANCOVA Summary Table for Self-Esteem Scores

Source	SS	df	MS	F	η^2
Pretest	312.45	1	312.45	28.34***	.27
Group	503.23	1	503.23	45.67***	.37
Error	848.67	77	11.02		

Note. ***p < .001

Fig 3: Variance Explained in Post-Intervention Self-Esteem (ANCOVA Results)
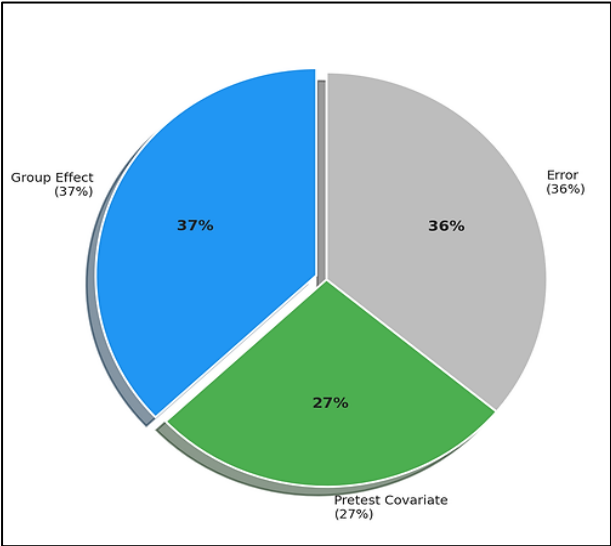
Paired samples t-tests were executed to scrutinize within-cohort alterations. The treatment cohort exhibited a statistically meaningful elevation in self-regard indices, $t(39) = 18.35$, $p < .001$, $d = 2.03$ (substantial effect). The comparison cohort manifested no meaningful alteration, $t(39) = 1.56$, $p = .127$, $d = 0.18$ (trivial effect).

Table 4. Paired Samples t-test Results

Group	Mean Diff (SD)	T	P	d
Experimental	8.33 (2.87)	18.35	< .001	2.03
Control	0.77 (1.98)	1.56	.127	0.18

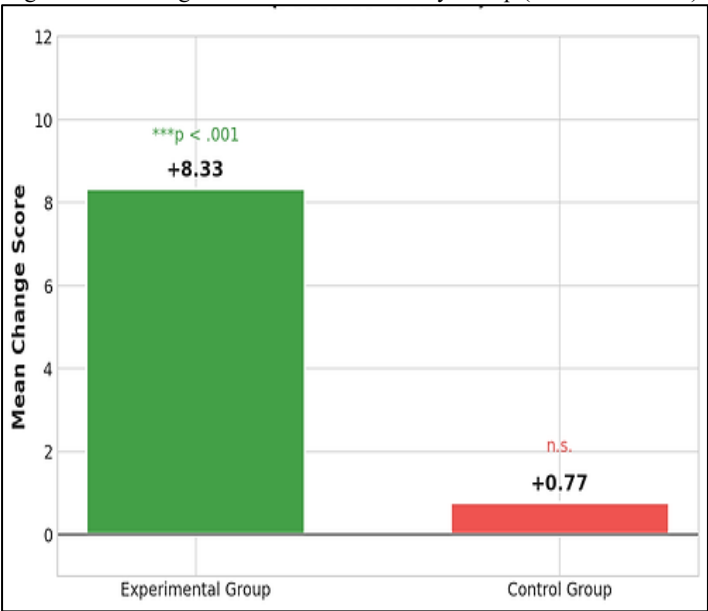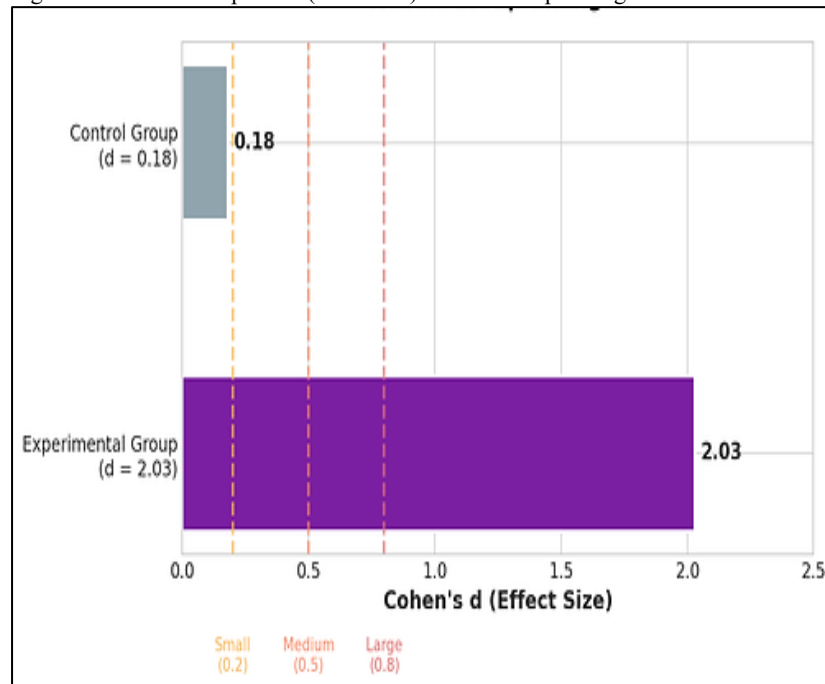Fig 4: Mean Change in Self-Esteem Scores by Group (Posttest- Pretest)

Fig 5: Effect Size Comparison (Cohen's d) Within Group Changes

IV. DISCUSSION

The present inquiry probed the efficacy of Transactional Analysis group programming for augmenting self-regard among Kerala's collegiate learners. Outcomes furnish compelling substantiation for the research predictions, revealing that individuals receiving the TA intervention manifested meaningfully superior improvements in self-worth relative to comparison cohort members. The substantial effect magnitude (partial η^2 = .37) signifies the intervention wielded a consequential and pragmatically meaningful influence on self-esteem.

These outcomes accord with antecedent scholarship substantiating TA intervention utility for bolstering self-worth and psychological wellness. (Torkaman et al., 2020) comparably discovered meaningful self-regard improvements subsequent to TA group treatment within a clinical cohort. Multiple conceptual mechanisms within TA theory may elucidate the documented self-regard enhancements, including work with life positions and ego states.

4.1. Limitations

Multiple constraints warrant acknowledgment when construing these outcomes. The quasi-experimental methodology precludes equivalent causal inference levels as genuine randomized controlled experimentation. The investigation omitted follow-up evaluations, and the sample derived from a single Kerala district, potentially constraining transferability.

4.2. Implications and Recommendations

The outcomes bear consequential ramifications for psychological wellness provisions within academic establishments throughout Kerala. Prospective scholarship should employ randomized experimental configurations and incorporate follow-up evaluations to fortify causal determinations and appraise outcome durability.

V. CONCLUSION

The present investigation furnishes substantiation endorsing Transactional Analysis group programming's efficacy for bolstering self-regard among Kerala's collegiate learners. The meaningful enhancements manifested within the treatment cohort, coupled with the substantial effect magnitude, intimate that TA constitutes a valuable intervention methodology for addressing self-worth concerns within this demographic.

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A Trend Analysis of Teacher Retention and Attrition Patterns in Government Schools: Evidence from National Educational Statistics (2015–2023)

Assanu Augustine

Assistant Professor, Department of Mathematics, Marian College Kuttikkanam (Autonomous),
Mahatma Gandhi University, Kottayam, Kerala, India.

Abstract

Teacher retention and attrition represent critical challenges in the Indian education system, particularly within government schools. This study employs a secondary data analysis approach to examine longitudinal trends in teacher workforce dynamics across Indian government schools from 2015 to 2023. Drawing upon data from the Unified District Information System for Education Plus (UDISE+), Parliamentary Standing Committee Reports, and Ministry of Education statistics, the research investigates patterns of teacher vacancies, contractual employment, regional disparities, and their implications for educational quality. The findings reveal persistent structural challenges including approximately 10 lakh vacant teaching positions, disproportionate distribution between rural and urban areas, and an increasing reliance on contractual teachers. The study identifies key factors influencing attrition including inadequate compensation, limited career progression, excessive administrative burden, and geographical deployment concerns. Regional analysis demonstrates significant interstate variations, with states like Bihar, Uttar Pradesh, and Jharkhand accounting for over half of total vacancies. The research contributes to policy discourse by recommending evidence-based interventions aligned with the National Education Policy 2020, emphasizing the urgent need for systematic recruitment, improved service conditions, and rationalized teacher deployment strategies to achieve the envisioned pupil-teacher ratio of 30:1.

I. INTRODUCTION

The teaching profession occupies a pivotal position in shaping human capital and national development. Teachers constitute the most significant school-based determinant of student achievement, making their recruitment, retention, and professional development matters of paramount policy concern (Borman & Dowling, 2008; Nguyen et al., 2020). The Indian school education system, one of the largest globally with nearly 14.72 lakh schools, over 98 lakh teachers, and approximately 24.8 crore students, faces persistent challenges in maintaining an adequate and qualified teaching workforce (Ministry of Education, 2024).

Teacher attrition, defined as teachers exiting their current schools through transfers, resignations, or departures from the profession, significantly impacts educational quality and equity. Research demonstrates that teacher turnover negatively affects student achievement, including students whose teachers remained (Ronfeldt et al., 2013). The National Education Policy (NEP) 2020 acknowledges these concerns, positioning teachers at the centre of educational reforms and mandating a pupil-teacher ratio (PTR) of under 30:1, with areas having socio-economically disadvantaged students aiming for 25:1 (Ministry of Education, 2020).

Despite policy commitments, Parliamentary Standing Committee reports consistently highlight approximately 10 lakh vacant teaching positions across government schools, raising questions about the system's capacity to deliver quality education (Parliamentary Standing Committee, 2023, 2025). The proliferation of contractual teacher appointments, single-teacher schools, and interstate disparities in teacher distribution compound these challenges. This study aims to analyse longitudinal

trends in teacher retention and attrition patterns in Indian government schools from 2015 to 2023, examining underlying factors and proposing evidence-based policy recommendations.

The research questions guiding this study are:

- What are the longitudinal trends in teacher vacancies and workforce composition in Indian government schools?
- What regional disparities exist in teacher distribution and attrition?
- What factors contribute to teacher attrition in the Indian context?
- What policy implications emerge for achieving NEP 2020 goals?

II. LITERATURE REVIEW

2.1. Global perspectives on teacher attrition

The international literature on teacher attrition identifies multiple moderating factors spanning personal characteristics, workplace conditions, and policy environments. (Borman & Dowling, 2008) comprehensive meta-analysis of 34 studies identified that teacher attrition is influenced by personal and professional factors that evolve across career paths, with workplace conditions playing a more substantial role than previously acknowledged. Their findings suggest attrition represents a problem addressable through targeted policies and initiatives.

(Nguyen et al., 2020) updated this synthesis through analysis of 120 studies, emphasizing the evolving nature of teacher labour markets and policy initiatives. Their expanded conceptual framework highlights burnout dimensions, job satisfaction, and organizational characteristics as key predictors of turnover intentions. Meta-analytic findings indicate significant positive relationships between exhaustion ($r+ = 0.41$), depersonalization ($r+ = 0.32$), reduced accomplishment ($r+ = 0.21$), and teachers' intentions to quit.

2.2. The Indian context: structural challenges

Research on Indian teacher workforce dynamics reveals unique structural challenges. (Muralidharan & Sundararaman ,2013) examined contract teachers through experimental evidence from Andhra Pradesh, finding that contract teachers demonstrated at least comparable effectiveness to regular civil-service teachers while earning approximately one-fourth the salary. However, they cautioned that contract mechanisms "as they are" have limitations, with teachers showing fairly low average effort in absolute terms.

(Ramachandran et al., 2018) conducted multi-state studies examining contractual employment's political economy, noting that protests, strikes, and litigation consume substantial administrative and teacher time. States like Rajasthan and Madhya Pradesh, early adopters of contract teachers, have either reversed or significantly modified their policies, indicating implementation challenges. (Das et al., 2016) estimated the fiscal cost of teacher absence at $1.5 billion annually, finding 23.6% teachers absent during unannounced visits. Their analysis suggests that investing in monitoring could be ten times more cost-effective than hiring additional teachers.

Recent qualitative research by (Sahu &Sharma ,2023) explored precarity among contract teachers in Odisha, identifying six dimensions of vulnerability: prioritization of non-teaching work, financial hardships, sense of inferiority, transfer anxiety, discrimination experiences, and desires for course correction. These findings illuminate the human costs of contractual employment policies.

2.3. Policy framework: RTE Act and NEP 2020

The (Right to Education Act, 2009) established normative benchmarks including a PTR of 30:1 for primary schools and 35:1 for upper primary and secondary levels. The NEP 2020 reaffirms these standards while emphasizing foundational literacy and numeracy, teacher professional development, and the establishment of a National Professional Standards for Teachers. The policy acknowledges that achieving universal access requires filling teacher vacancies at the earliest, ensuring appropriate PTRs, and providing continuous professional development (Ministry of Education, 2020). However, (Kingdon ,2025) challenges conventional narratives about teacher shortages, arguing that after adjusting for small schools with surplus teachers and removing potential enrollment inflation, India may have a net surplus rather than deficit of teachers, highlighting the complexity of workforce planning.

III. METHODS

3.1. Research design

This study employs a descriptive-analytical research design utilizing secondary data analysis. The approach enables examination of large-scale national datasets to identify patterns, trends, and correlations in teacher workforce dynamics. Secondary data analysis offers advantages of accessing comprehensive, nationally representative information while enabling longitudinal comparisons across multiple years.

3.2. Data sources

The primary data sources include:

- Unified District Information System for Education Plus (UDISE+) reports from 2018-19 to 2023-24, providing comprehensive statistics on schools, teachers, enrollment, and infrastructure

- Parliamentary Standing Committee Reports on Education (2023, 2025) containing data on teacher vacancies, sanctioned posts, and recruitment status;
- Ministry of Education Annual Reports and Parliamentary Questions responses;
- Education International Research reports
- Published academic literature on teacher workforce in India.

The UDISE+ system, operational since 2018-19, represents India's comprehensive school education database covering over 14.7 lakh schools, 98 lakh teachers, and 24.8 crore students.

3.3. Analytical framework

Data analysis involved descriptive statistical techniques including trend analysis, percentage calculations, and comparative analysis across states and time periods. The analytical framework examined:

- Teacher vacancy trends at elementary and secondary levels;
- Sanctioned versus filled positions;
- Contractual versus permanent teacher proportions;
- Regional variations in teacher distribution;
- Pupil-teacher ratios across education levels; and
- Single-teacher school prevalence.

3.4. Limitations

The study acknowledges limitations inherent in secondary data analysis. The transition from UDISE to UDISE+ in 2018-19 introduced methodological changes affecting direct comparisons with earlier data. The further transition to Student Data Management Information System (SDMIS) in 2022-23 similarly affects comparability. Additionally, self-reported administrative data may contain inconsistencies or reporting variations across states.

IV. RESULTS

4.1. National trends in teacher workforce

Analysis of UDISE+ data reveals modest improvements in the overall teaching workforce. Total teachers increased from 94.3 lakh in 2018-19 to 95.07 lakh in 2021-22, and further to approximately 98 lakh by 2023-24. Despite this growth, persistent vacancies remain a significant concern. The (Parliamentary Standing Committee, 2025) reported that in 2023-24, out of 63,26,207 sanctioned teaching posts at primary and secondary levels, 9,59,148 remained vacant. By 2024-25, sanctioned posts increased to 69,85,760, but vacancies also rose to 9,82,662.

Table 1. Teacher Vacancies by Education Level (2023-24 to 2024-25)

Level	Vacancies 2023-24	Vacancies 2024-25
Elementary	7,24,000	5,72,000
Secondary	2,34,000	4,09,000
Total	9,59,148	9,82,662

Source: Parliamentary Standing Committee Report (2025)

4.2. Regional disparities in teacher distribution

Significant interstate variations characterize teacher distribution across India. Data from December 2023 indicates that Bihar, Uttar Pradesh, and Jharkhand collectively account for more than half of total vacancies at primary and secondary levels. Bihar alone reported over 2.25 lakh teaching vacancies, despite announcing large-scale recruitment drives. Conversely, states including Goa, Kerala, Maharashtra, Meghalaya, Nagaland, and Odisha reported zero vacancies at the primary level, while Kerala, Maharashtra, Nagaland, Odisha, and Sikkim reported zero vacancies at the secondary level.

The rural-urban divide presents additional concerns. Approximately 75% of teachers work in rural areas, yet rural schools demonstrate adverse infrastructure indicators. Only 18.47% of rural schools have internet access compared to 47.29% of urban schools. Furthermore, 1,17,285 single-teacher schools were reported in 2021-22, with 89% located in rural areas. By 2024-25, single-teacher schools decreased to 1,04,125, representing a 6.2% reduction but still affecting 3.37 million students.

4.3. Contractual employment patterns

The proliferation of contractual teacher appointments represents a significant trend. The (Parliamentary Standing Committee ,2025) strongly opposed hiring teachers on contractual basis, noting it undermines constitutional provisions of reservation for SC, ST, and OBC communities in government jobs. Even centrally administered institutions including Kendriya Vidyalayas (KVs) and Jawahar Navodaya Vidyalayas (JNVs) reported 30-50% vacancies being filled through contractual appointments. Notably, the National Council for Teacher Education (NCTE) itself has not recruited permanent teaching or non-teaching staff since 2019, with 54% of Group A posts, 43% of Group B posts, and 89% of Group C posts remaining vacant.

4.4. Pupil-teacher ratio trends

Despite workforce challenges, aggregate PTR data shows improvement. The national PTR at primary level improved

from 26:1 to 20:1 between 2018-19 and 2024-25. Stage-specific ratios in 2024-25 stood at: Foundational - 10:1, Preparatory - 13:1, Middle - 17:1, and Secondary - 21:1, all surpassing NEP's 30:1 benchmark. However, these aggregates mask significant state-level variations, with Bihar maintaining PTRs exceeding 26:1. The improvement in aggregate PTR alongside persistent vacancies reflects declining enrollment in government schools, with 1.5 crore students dropping out between 2021-22 and 2022-23.

V. DISCUSSION

The findings illuminate a complex landscape of teacher workforce challenges in Indian government schools. The persistence of approximately 10 lakh vacancies despite policy commitments suggests systemic barriers to recruitment and retention. Several factors merit discussion.

First, the structural issue of contractual employment creates precarity that affects teacher motivation and professional identity. Research indicates contract teachers experience financial hardships, sense of inferiority, and anxiety about transfers (Sahu et al., 2023). While some evidence suggests contract teachers demonstrate higher effort rates (Muralidharan & Sundararaman, 2013), the human costs and constitutional implications of bypassing reservation provisions demand reconsideration of this approach.

Second, the paradox of improved aggregate PTRs alongside persistent vacancies reflects broader demographic and educational dynamics. The rapid growth of private schooling, RTE Act provisions mandating 25% reservation in private schools, and declining fertility rates have contributed to reduced enrollment in government schools. (Kingdon, 2025) provocatively argues this creates a potential teacher surplus rather than shortage when accounting for small schools. This perspective, while contested, highlights the need for rationalized deployment strategies rather than simple recruitment expansion.

Third, interstate disparities demand differentiated policy approaches. The concentration of vacancies in educationally disadvantaged states including Bihar, Uttar Pradesh, and Jharkhand reflects broader governance and resource allocation challenges. Conversely, states demonstrating zero vacancies may offer implementation models worthy of examination and adaptation.

Fourth, the prevalence of single-teacher schools, predominantly in rural areas, raises concerns about educational quality and teacher workload. Multi-grade teaching in resource-constrained environments challenges effective pedagogy and limits student learning opportunities. The school complex model proposed under NEP 2020, consolidating resources across clusters, offers a potential structural solution.

Finally, the six-year hiring freeze in NCTE itself symbolizes systemic neglect of teacher education infrastructure. Building teacher capacity requires institutional strengthening at regulatory and training levels alongside school-level recruitment. The Parliamentary Standing Committee's directive to fill vacancies by March 2026 represents a necessary but insufficient response without addressing underlying systemic constraints.

VI. CONCLUSION

This study examined longitudinal trends in teacher retention and attrition patterns in Indian government schools from 2015 to 2023. The analysis reveals persistent challenges including approximately 10 lakh vacant positions, significant interstate disparities concentrated in educationally disadvantaged states, increasing reliance on contractual appointments, and continued prevalence of single-teacher schools in rural areas.

The findings support several policy recommendations. First, time-bound recruitment of permanent teachers should replace contractual appointments, ensuring compliance with constitutional reservation provisions. Second, rationalized teacher deployment strategies should address mismatches between teacher availability and student enrollment patterns. Third, improved service conditions including competitive compensation, career progression pathways, and reduced administrative burden are essential for retention. Fourth, strengthening teacher education institutions, particularly DIETs, will build long-term capacity. Fifth, the school complex model should be expedited to optimize resource utilization in rural areas.

Future research should examine state-specific implementation experiences, the impact of contractual employment on student outcomes, and the effectiveness of various retention interventions. Longitudinal studies tracking individual teacher career trajectories would provide granular insights into attrition factors. As India pursues NEP 2020's vision of universal quality education by 2030, addressing teacher workforce challenges remains foundational to success.

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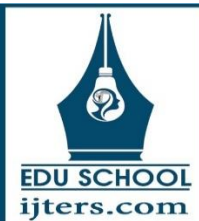
Teacher Attrition in Government Schools: A Mixed-Methods Study of Occupational Stress, Compensation, and Career Mobility

Vincent

Assistant Professor of English, Lakshmi College of Education, Gandhigram, Dindigul, Tamil Nadu, India

Abstract

Teacher attrition in government schools represents a critical challenge to educational quality and system sustainability. This comprehensive review synthesizes current research examining the complex interplay between occupational stress, compensation structures, and career mobility patterns that drive teacher departure from public education. Analysis of national data reveals that while overall attrition rates have remained relatively stable at approximately 8% annually, significant disparities exist across school contexts, with high-poverty schools experiencing turnover rates exceeding 20%. The review integrates quantitative findings on burnout prevalence (25-74%), stress levels (8-87%), and compensation gaps with qualitative insights on working conditions and professional satisfaction. Key findings indicate that occupational stress, characterized by workload intensity, administrative burdens, and inadequate support, serves as a primary predictor of burnout and subsequent attrition. Compensation emerges as a critical but insufficient factor, with teachers earning 19% less than comparably educated professionals in other sectors. Career mobility patterns reveal that teachers in high-need schools, beginning teachers, and those in shortage subject areas face elevated attrition risk. The conservation of resources theory and job demands-resources model provide theoretical frameworks for understanding how resource depletion accelerates burnout and turnover. Policy recommendations emphasize comprehensive approaches including competitive compensation, enhanced working conditions, strengthened induction and mentoring programs, and strategic differentiation of pay structures to address persistent staffing challenges in underserved schools.

I. INTRODUCTION

1.1. The Challenge of Teacher Attrition

Teacher attrition in government schools constitutes one of the most pressing challenges facing contemporary education systems worldwide. In the United States alone, approximately 8% of public school teachers leave the profession annually, with significantly higher rates in high-poverty and high-minority schools where turnover can exceed 20-30% (Carver-Thomas & Darling-Hammond, 2017; Taie et al., 2023). This persistent exodus of educators undermines educational quality, disrupts instructional continuity, and generates substantial financial costs, with estimates suggesting that teacher turnover costs U.S. schools approximately $2.2 billion annually (Sutcher et al., 2016).

The significance of teacher attrition extends beyond mere statistics. Teacher quality represents the single most important school-based factor influencing student achievement (Rivkin et al., 2005), and high turnover rates disproportionately affect the most vulnerable student populations. Schools serving predominantly students of color and students from low-income families experience the highest turnover rates, exacerbating existing educational inequities (Ingersoll & May, 2012). Moreover, the departure of experienced, effective teachers creates a persistent staffing crisis that forces schools to rely on less prepared educators or long-term substitutes, directly impacting student learning outcomes.

Despite decades of research attention, teacher attrition remains inadequately understood in its full complexity. While early research focused primarily on demographic predictors and simple supply-demand dynamics, contemporary scholarship recognizes attrition as a multifaceted phenomenon influenced by interconnected factors including occupational stress,

compensation structures, working conditions, administrative support, and career advancement opportunities (Borman & Dowling, 2008; Goldha ber & Theobald, 2022). Understanding the intricate relationships among these factors requires integrating multiple theoretical perspectives and research methodologies.

1.2. Theoretical Frameworks

This review employs two primary theoretical frameworks to understand teacher attrition. The Conservation of Resources (COR) theory (Hobfoll, 1989, 2001) posits that individuals strive to obtain, retain, and protect valued resources, and psychological stress occurs when these resources are threatened or lost. Applied to education, teachers invest substantial personal, emotional, and cognitive resources in their work. When job demands consistently exceed available resources without adequate replenishment, resource depletion occurs, manifesting as burnout and potentially leading to attrition.

The Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2006; Demerouti et al., 2001) complements COR theory by distinguishing between job demands (aspects requiring sustained effort) and job resources (factors that facilitate goal achievement and buffer demands). The model proposes dual pathways: a health impairment process whereby excessive demands lead to exhaustion and stress, and a motivational process where adequate resources promote engagement and commitment. Teacher attrition occurs when the balance tips decisively toward demands, overwhelming protective resources.

1.3. Research Objectives

This comprehensive review examines the current state of knowledge regarding teacher attrition in government schools, with particular emphasis on three interconnected dimensions

- Occupational stress and burnout as psychological mechanisms driving attrition
- Compensation structures and their role in recruitment and retention
- Career mobility patterns that characterize teacher movement within and out of the profession.

By synthesizing quantitative and qualitative research across these domains, this review aims to provide actionable insights for policymakers, administrators, and educational leaders seeking to address the teacher attrition crisis.

II. LITERATURE REVIEW

2.1. Scope and Magnitude of Teacher Attrition

2.1.1. National Trends and Patterns

Recent national data from the Teacher Follow-up Survey (TFS) indicates that approximately 84% of public school teachers remain in the same school year-to-year ("stayers"), 8% move to different schools ("movers"), and 8% leave the profession entirely ("leavers") (Taie et al., 2023). These aggregate figures, however, mask significant variation across contexts. The 2021-22 TFS data, collected during the COVID-19 pandemic recovery period, revealed attrition rates consistent with pre-pandemic levels, contradicting media narratives of a mass teacher exodus (Goldhaber et al., 2022).

Fig 1: Teacher Mobility and Attrition Trends in U.S. Public Schools, 2012-2022
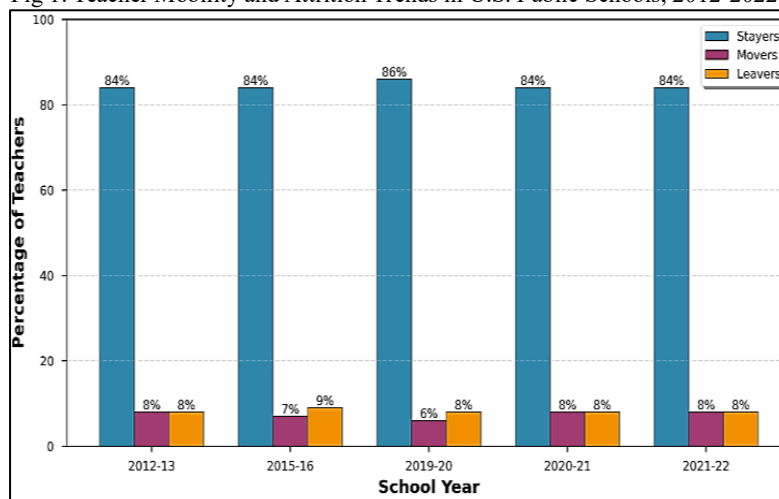
Data show the percentage distribution of teachers classified as stayers (remaining in same school), movers (transferring to different school), and leavers (exiting profession) across five survey cycles. Compiled from National Center for Education Statistics Teacher Follow-up Survey data (Taie et al., 2023).

Longitudinal analysis reveals that first-year teachers face the highest attrition risk, with approximately 10-15% leaving after their initial year and nearly 30% departing within five years (Ingersoll et al., 2014). The Beginning Teacher Longitudinal Study documented that among teachers who began in 2007-08, 17% had left by year five, with higher rates among alternatively certified teachers (30%) compared to traditionally prepared educators (15%) (Gray & Taie, 2015).

2.1.2. Differential Attrition by School Characteristics

Attrition rates vary dramatically based on school characteristics, particularly socioeconomic composition and urbanicity. Schools with high concentrations of students receiving free or reduced-price lunch experience turnover rates 50% higher than more affluent schools (Simon & Johnson, 2015). Geographic analysis indicates highest turnover in the South (16%) and lowest in the Northeast (10%), correlating with regional differences in teacher compensation, class sizes, and educational investment (Sutcher et al., 2016).

Urban schools face particularly acute challenges, with annual turnover often exceeding 20%. However, contrary to conventional wisdom, some research indicates that certain rural and town settings in the western United States also experience elevated turnover, likely due to geographic isolation and limited amenities (Monk, 2007). Private schools demonstrate higher leaving rates (12%) compared to public schools (8%), though interpretation requires considering different compensation structures and working conditions between sectors.

2.1.3. Subject Area and Specialty Disparities

Teachers in shortage areas face heightened attrition risk. Mathematics, science, special education, and English language development teachers leave at higher rates than colleagues in other fields (Ingersoll & Perda, 2010). These subject specialists often possess credentials marketable outside education, facing opportunity costs that make retention particularly challenging. Special education teachers experience turnover rates 25% higher than general education teachers, attributed to high paperwork demands, challenging student behaviors, and inadequate administrative support (Billingsley & Bettini, 2019).

Table 1. Summary of Teacher Attrition Rates by School Characteristics

School Characteristic	Stayers(%)	Movers (%)	Leavers (%)	Total Turnover (%)
Overall Public Schools	84	8	8	16
High-Poverty Schools	82	9	9	18
Low-Poverty Schools	85	7	8	15
Urban Schools	80	10	10	20
Suburban Schools	86	7	7	14
Rural Schools	83	8	9	17
High-Minority Schools	81	9	10	19
Low-Minority Schools	86	7	7	14
Beginning Teachers (0-3 yrs)	75	12	13	25
Experienced Teachers (15+ yrs)	86	6	9	15

Note. Data compiled from Taie et al. (2023) and Carver-Thomas & Darling-Hammond (2017). Percentages may not sum to 100% due to rounding. High-poverty defined as ≥75% students eligible for free/reduced-price lunch; low-poverty as <35%. High-minority defined as ≥75% students of color.

III. OCCUPATIONAL STRESS AND BURNOUT

3.1. Conceptual Foundations

Teacher burnout represents a psychological syndrome arising from prolonged exposure to occupational stressors, characterized by three dimensions: emotional exhaustion (depletion of emotional resources), depersonalization (cynical attitudes toward students and work), and reduced personal accomplishment (feelings of inefficacy) (Maslach et al., 2001). While distinct from acute stress, burnout develops through cumulative exposure to chronic work demands without adequate recovery or resource replenishment.

Recent scoping reviews examining 133 studies across multiple continents report troubling prevalence rates: moderate to severe burnout affects 25-74% of teachers, stress levels range from 8-87%, anxiety from 38-41%, and depression from 4-77% (Madigan & Kim, 2021; Sokal et al., 2020). These wide ranges reflect methodological variations, cultural contexts, and measurement approaches, yet collectively indicate that psychological distress among teachers constitutes a global public health concern.

Fig 2: Primary Contributors to Occupational Stress Among Teachers.
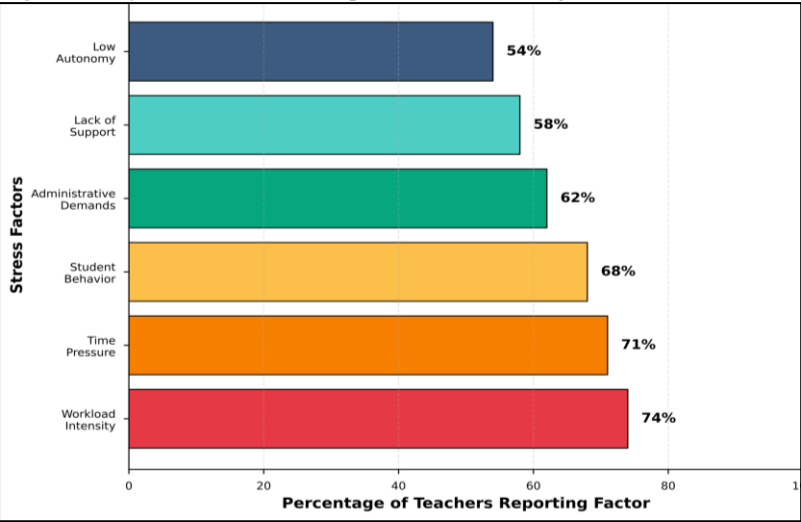
Horizontal bar chart displays the percentage of teachers reporting each factor as a significant source of occupational stress. Data synthesized from multiple studies examining teacher stress correlates (N > 15,000 teachers). Factors include workload intensity, student behavior challenges, administrative demands, lack of support, time pressure, and reduced autonomy.

3.2. Sources of Occupational Stress

3.2.1. Workload and Time Pressure

Excessive workload emerges as the most consistently cited stressor across studies. Teachers report working an average of 10-12 hours daily, extending well beyond contracted hours for lesson planning, grading, and administrative tasks (Skaalvik & Skaalvik, 2017). Time pressure operates as the strongest predictor of emotional exhaustion, with teachers struggling to balance instructional duties, assessment requirements, parent communication, and professional development mandates (Hakanen et al., 2006).

The intensification of work demands has accelerated in recent decades through expanded curricula, increased accountability testing, and proliferation of documentation requirements. Many teachers describe feeling perpetually behind, unable to provide the quality instruction they desire due to time constraints. This chronic sense of inadequacy contributes significantly to reduced personal accomplishment and eventual burnout.

3.2.2. Student Behavior and Classroom Management

Managing challenging student behaviors constitutes a major stressor, particularly for beginning teachers and those in schools with concentrated poverty. Disruptive behaviors, lack of motivation, and serious disciplinary issues drain emotional resources and create unsafe environments (Dicke et al., 2018). Low student motivation emerges as the strongest predictor of cynicism, as teachers struggle to engage disinterested learners, questioning their professional efficacy and purpose.

Research documents substantial variation in behavior challenges across school contexts. Teachers in high-poverty urban schools report higher frequencies of serious misconduct, physical confrontations, and threats to personal safety. The emotional labor of managing these situations while maintaining instructional focus and professional composure depletes psychological resources rapidly.

3.2.3. Administrative Demands and Bureaucracy

The proliferation of administrative tasks unrelated to instruction generates significant frustration. Teachers report spending excessive time on paperwork, compliance documentation, meeting attendance, and data entry systems. These demands feel particularly burdensome because they detract from activities teachers view as core to their profession: working directly with students and developing engaging lessons.

Special education teachers face especially heavy administrative burdens through Individualized Education Program (IEP) development, progress monitoring documentation, and compliance procedures. Many report that paperwork consumes time that could otherwise support individualized student instruction, creating ethical distress about professional priorities.

3.2.4. Lack of Autonomy and Professional Voice

Teachers increasingly report diminished autonomy over instructional decisions, curriculum selection, and assessment approaches. Scripted curricula, pacing mandates, and standardized testing pressures constrain professional judgment. This reduction in autonomy correlates negatively with self-perceived accomplishment, as teachers feel deskilled and disrespected as professionals (Pearson & Moomaw, 2005).

Working in value-dissonant contexts where personal educational philosophies conflict with mandated approaches—strongly predicts cynicism. Teachers who entered the profession with ideals about nurturing creativity and critical thinking but find themselves implementing test-preparation drills experience profound disillusionment.

3.2.5. Inadequate Support and Resources

Lack of administrative support, colleague collaboration, and material resources exacerbates stress. Principals' leadership quality significantly influences teacher retention decisions, with supportive, instructionally focused leaders reducing turnover by 30-40% (Kraft et al., 2016). Conversely, unsupportive administrators who fail to address discipline issues, provide meaningful feedback, or buffer external demands accelerate attrition.

Insufficient mentoring for beginning teachers represents a critical gap. Teachers receiving high-quality induction support show retention rates double those of unsupported peers (Ingersoll & Strong, 2011). However, only 59% of beginning teachers receive consistent mentoring from both a designated mentor and their principal, a proportion that has declined in recent years.

3.2.6. Stress-Burnout-Attrition Pathway

Longitudinal research confirms that occupational stress predicts burnout, which in turn predicts attrition intentions and actual departure (Skaalvik & Skaalvik, 2017). The pathway operates through both direct and mediated mechanisms. Directly, chronic stress depletes coping resources, leading to physical and mental health deterioration that may necessitate departure. Indirectly, stress reduces job satisfaction and organizational commitment, making alternative employment increasingly attractive.

Work-family conflict serves as a crucial mediator. As job demands intrude on personal and family time, teachers experience resource loss in multiple life domains. This spillover effect intensifies burnout, particularly for teachers with

dependent children. Interestingly, recent research suggests that for teachers with high self-efficacy, work-family conflict actually shows stronger effects on burnout, challenging assumptions about self-efficacy as purely protective (Wu et al., 2022).

3.2.7. Individual and Contextual Moderators

Not all teachers experiencing stress progress to burnout and attrition. Protective factors include psychological capital (optimism, resilience, self-efficacy), strong professional identity, positive coping strategies, and perceived social support (Gu & Day, 2013). Teachers with high psychological capital maintain engagement even under demanding conditions, viewing challenges as surmountable rather than overwhelming.

Contextual factors moderate the stress-burnout relationship substantially. Supportive school climate, collaborative culture, and respectful leadership buffer demands. Adequate resources, reasonable class sizes, and protected planning time prevent resource depletion. These findings underscore that while individual resilience matters, structural and organizational factors prove equally or more critical in preventing burnout.

Table 2. Prevalence of Psychological Distress Among Teachers

Condition	Range of Prevalence	Median (%)	Studies (n)
Burnout (Moderate-Severe)	25-74	42	32
Occupational Stress	8.87	38	29
Anxiety	38-41	40	12
Depression	4-77	28	55
Emotional Exhaustion	31-68	47	28
Depersonalization	22-54	35	24
Reduced Accomplishment	18-43	29	21

Note. Compiled from systematic reviews by Madigan & Kim (2021) and Sokal et al. (2020). Wide ranges reflect methodological differences, cultural contexts, and measurement approaches across studies. Prevalence rates represent clinically meaningful (moderate to severe) symptoms.

IV. COMPENSATION AND ECONOMIC FACTORS

4.1. The Teacher Pay Gap

4.1.1. Comparative Earnings Analysis

Teacher compensation relative to other professionals with comparable education constitutes a longstanding concern. Using hourly wage comparisons to account for teachers' shorter work years, research indicates public school teachers earn approximately 19% less than similarly educated workers in other sectors (Allegretto & Mishel, 2019). This "teacher pay penalty" has grown from 2% in 1994 to its current level, coinciding with declining teacher pipeline interest.

The gap proves particularly pronounced at career entry. Beginning teacher salaries average $40,000-45,000 nationally, substantially below starting salaries for other bachelor's degree holders in fields like engineering, business, and computer science (National Council on Teacher Quality, 2022). This starting salary disadvantage significantly hampers recruitment of top-performing college graduates, who increasingly pursue more lucrative careers.

4.1.2. Regional and District Variation

Substantial geographic variation characterizes teacher compensation. Teachers in Northeastern states and certain urban districts earn salaries 40-60% higher than colleagues in Southern and rural districts. These differences only partially reflect cost-of-living adjustments, with some high-cost areas actually providing below-average real compensation (Goldhaber et al., 2015).

Within-district variation also exists, though traditional salary schedules limit flexibility. The single-salary schedule, determining pay solely by experience and credentials, dominates public education. While intended to promote equity, this structure fails to differentiate for market conditions, making recruitment in shortage areas and high-need schools particularly challenging.

4.1.3. Total Compensation Considerations

Analyses limited to salary understate true compensation by excluding benefits. Teachers typically receive generous health insurance, defined-benefit pensions, and job security protections. When these factors are included, some economists argue teachers enjoy compensation parity or slight advantages (Biasi, 2021; Richwine & Biggs, 2011).

However, this claim requires careful scrutiny. First, pension benefits disproportionately accrue to long-serving teachers, providing little incentive for early-career teachers most prone to attrition. Second, job security value depends on employment alternatives; in tight labor markets, security becomes less valuable. Third, monetizing benefits ignores qualitative working condition differences stress, workload, and autonomy that make direct comparisons misleading.

Fig 3: Teacher Retention Rates by Compensation Level.
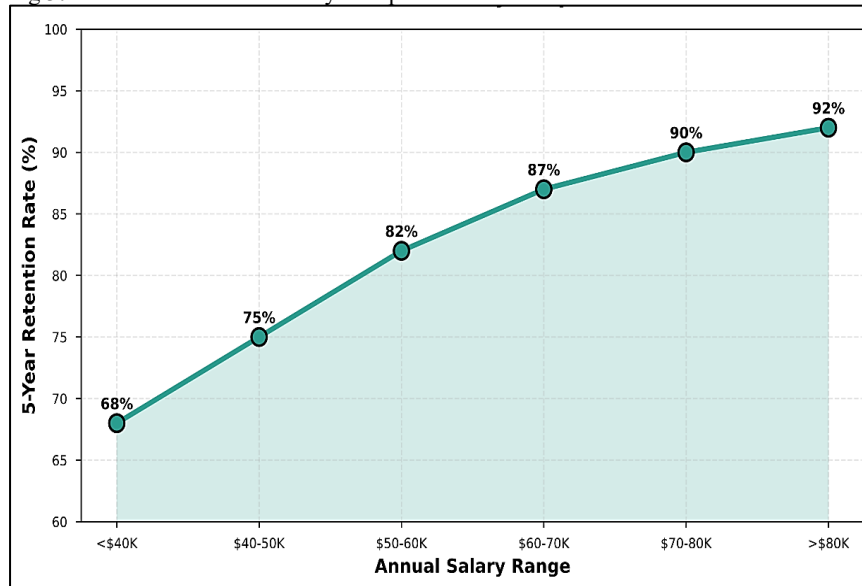
Line graph illustrates the relationship between annual salary ranges and five-year retention rates. Higher compensation correlates with improved retention, with effects particularly pronounced at early-career salary thresholds. Data compiled from longitudinal studies tracking teacher career trajectories across diverse compensation contexts.

4.1.4. Compensation and Retention

Research consistently demonstrates that higher salaries associate with lower attrition. A $5,000 salary increase correlates with 5-10% reduction in turnover (Clotfelter et al., 2008). These effects prove particularly strong for beginning teachers and those working in challenging schools. Conversely, salary dissatisfaction strongly predicts turnover intentions and actual departure (Guarino et al., 2006).

Strategic compensation interventions show promise. Targeted bonuses for teaching in high-need schools, shortage subject areas, or demonstrating strong performance can improve recruitment and retention by 15-25% when designed appropriately (Springer et al., 2016). However, bonus programs have shown mixed results, succeeding when substantial ($10,000+), sustained, and embedded within supportive working conditions, but failing when small, short-term, or implemented in toxic environments.

4.1.5. Compensation, Recruitment, and Quality

Higher salaries not only improve retention but also strengthen the teacher pipeline. Research indicates that a 10% salary increase raises the proportion of college graduates willing to enter teaching by 26% (Manski, 1987). More recent evidence confirms that compensation significantly influences career selection, with high-achieving students citing low pay as the primary deterrent to teaching careers (Croft et al., 2018).

Importantly, compensation affects not just quantity but quality of applicants. Districts offering higher salaries attract candidates with stronger academic credentials, higher test scores, and more competitive undergraduate institutions (Figlio, 1997). These quality differences persist throughout careers, with higher-paid districts showing superior teacher performance on value-added measures.

4.1.6. Compensation and Equity

The relationship between compensation and student outcomes reveals important equity dimensions. Higher teacher salaries correlate with reduced achievement gaps between White students and Black or Hispanic students, likely because better compensation enables recruitment and retention of effective teachers in schools serving predominantly minority students (García & Han, 2022). This finding suggests compensation policy represents not merely a labor market issue but an equity imperative.

V. CAREER MOBILITY PATTERNS

5.1. Movement Within Education

Teacher mobility encompasses not only departures but also movement between schools. Approximately half of teacher turnover involves transfers to different schools rather than profession exit (Ingersoll & May, 2012). Understanding these mobility patterns proves crucial because inter-school movement concentrates in predictable patterns, exacerbating inequity.

Teachers consistently move from high-poverty, high-minority, urban schools toward more affluent, suburban schools when opportunities arise (Hanushek et al., 2004). This directional flow means disadvantaged schools function as "entry points" and "training grounds," losing teachers to more desirable placements as soon as educators gain experience. Consequently, these schools disproportionately employ novice teachers, perpetuating achievement gaps.

Reasons for school-to-school movement differ from profession exit. Movers cite dissatisfaction with administration (43%), desire for better salary/benefits (30%), and pursuit of better teaching assignment (25%) as primary motivations (Taie et al., 2023). These factors prove more amenable to policy intervention than reasons for leaving teaching entirely, suggesting strategic retention efforts should distinguish between movement types.

5.2. Demographic Patterns in Mobility

Female teachers, who comprise 76% of the workforce, show slightly lower attrition rates than males, likely reflecting different career opportunity structures and labor market conditions (Ingersoll et al., 2014). However, female teachers with young children face elevated turnover risk due to work-family conflict, particularly when school schedules conflict with childcare needs.

Teachers of color demonstrate complex mobility patterns. While exhibiting overall higher turnover rates, these differences largely disappear when controlling for school characteristics. Teachers of color disproportionately work in high-poverty, high-minority schools with challenging conditions, explaining elevated attrition (Ingersoll & May, 2012). Within similar school contexts, retention rates prove comparable across racial groups, highlighting the importance of school working conditions over individual characteristics.

Age and experience strongly predict mobility. Beginning teachers face highest attrition risk in years 1-5, with attrition declining through mid-career before rising again as teachers approach retirement eligibility. This U-shaped pattern creates two distinct turnover challenges: retaining promising early-career teachers and managing retirement-driven departures.

5.3. Alternative Pathways and Second Careers

The teaching profession attracts substantial numbers of career changers—individuals entering education after establishing careers elsewhere. These second-career entrants bring valuable real-world experience but also face unique challenges. They often enter through alternative certification pathways, receiving less comprehensive preparation and facing higher attrition rates (30% vs. 15% within five years) than traditionally certified peers (Gray & Taie, 2015).

Conversely, teachers who leave education pursue diverse second careers. Common destinations include educational administration, education-adjacent fields (instructional coaching, curriculum development), and non-education occupations. Contrary to assumptions about teachers leaving for higher-paying private sector jobs, many departing teachers actually accept lower-paid positions, suggesting that compensation alone fails to explain attrition fully (Goldhaber et al., 2020). Working conditions, stress levels, and professional satisfaction prove equally determinative.

5.4. School Leadership and Retention

Principal quality exerts profound influence on teacher retention. Effective instructional leadership—providing meaningful feedback, protecting instructional time, facilitating collaboration, and creating positive school climate—reduces teacher turnover by 30-40% (Boyd et al., 2011). Principals serve as buffers between teachers and external demands, advocates for resources and support, and shapers of professional culture.

The mechanisms through which leadership affects retention include direct support (mentoring, professional development), working condition improvements (scheduling, resource allocation), and culture building (collegiality, shared purpose). Teachers who feel respected, valued, and professionally supported by leadership demonstrate dramatically higher retention, even in otherwise challenging schools.

VI. DISCUSSION

6.1. Integrated Understanding of Teacher Attrition

Teacher attrition emerges from this review as a complex, multidetermined phenomenon requiring integrated understanding across multiple levels. At the individual level, psychological resources, coping strategies, and professional identity influence how teachers experience and respond to job demands. At the organizational level, school leadership, colleague support, and available resources shape daily work experiences. At the systemic level, compensation structures, policy mandates, and societal respect for the profession create broader contexts influencing career sustainability.

The COR theory and JD-R model provide coherent frameworks for integrating these levels. Teachers enter the profession with finite personal resources time, energy, emotional capacity. Job demands continually deplete these resources through workload, stress, and emotional labor. When resources are replenished through adequate compensation, supportive leadership, professional development, and manageable working conditions, teachers maintain equilibrium. However, when demands chronically exceed resources without replenishment, depletion accelerates, manifesting as burnout and ultimately attrition.

Critical insight emerges from recognizing that attrition represents rational adaptation to untenable conditions rather than individual failure. Viewing departing teachers as "quitters" or "uncommitted" fundamentally misdiagnoses the problem. The majority of teachers leave due to working conditions, inadequate support, and unsustainable demands factors within organizational and policy control. Reframing attrition as systemic failure rather than individual limitation shifts responsibility appropriately toward institutional solutions.

6.2. Equity Implications

The unequal distribution of teacher attrition across school contexts represents a critical equity concern. High-poverty, high-minority schools experience turnover rates 50% higher than advantaged schools, meaning the students most needing

stable, experienced, effective teachers receive the least access. This inequitable distribution perpetuates achievement gaps and limits social mobility.

Multiple mechanisms produce this inequality. First, challenging working conditions in high-need schools—larger classes, more behavioral issues, less administrative support, fewer resources accelerate resource depletion and burnout. Second, lower compensation in many high-need districts makes recruitment and retention more difficult. Third, more experienced teachers exercise mobility privileges to transfer toward easier placements, leaving high-need schools with disproportionate novice populations.

Addressing attrition therefore constitutes not merely an efficiency concern but a justice imperative. Ensuring equitable access to stable, high-quality teaching requires targeted interventions in high-need contexts. Blanket, universal policies prove insufficient; strategic, differentiated approaches recognizing varied school realities are essential.

6.3. The COVID-19 Paradox

Recent research reveals a surprising finding: contrary to widespread media reports of mass teacher exodus during and after COVID-19, actual attrition rates remained stable or even declined slightly during 2019-2021 (Goldhaber et al., 2022). While teachers reported elevated stress, burnout, and dissatisfaction, these perceptions did not translate into commensurately elevated departure.

This paradox likely reflects multiple factors. Economic uncertainty and reduced labor market opportunities during the pandemic made career changes riskier. Remote instruction, while challenging, also reduced certain stressors like commuting and some behavioral issues. Perhaps most importantly, the gap between expressed intentions to leave and actual leaving proved substantial; only one-third of teachers reporting intent to leave actually do so.

The pandemic did, however, accelerate burnout and dissatisfaction even without immediate attrition increases. This suggests potential delayed effects—teachers remaining during crisis but departing once conditions normalize and alternatives become available. Indeed, preliminary evidence from 2023-2024 indicates turnover may be gradually rising toward pre-pandemic levels, suggesting the crisis may have simply postponed rather than prevented departures.

VII. RECOMMENDATIONS AND IMPLICATIONS

7.1. For Policy Makers

- Raise Base Salaries Competitively: Increase teacher compensation to levels competitive with other professions requiring similar education. Prioritize raising early-career salaries to strengthen pipeline recruitment.
- Implement Strategic Differentiation: Design targeted salary supplements for teachers in high-need schools, shortage subject areas, and demonstrating strong performance. Ensure incentives are substantial ($10,000+) and sustained.
- Invest in Induction and Mentoring: Mandate and fund comprehensive induction programs for beginning teachers, including reduced teaching loads, dedicated mentors, and protected planning time. Research indicates every dollar invested in induction returns $1.50 in reduced turnover costs.
- Address Working Conditions: Reduce class sizes, provide adequate planning time, minimize administrative burdens unrelated to instruction, and ensure sufficient resources. These "working condition" reforms often prove more cost-effective than compensation increases alone.
- Strengthen Leadership Development: Invest in principal preparation and support programs emphasizing instructional leadership, teacher support, and positive climate creation. Effective principals prove as cost-effective as substantial salary increases for retention.
- Reduce Testing and Accountability Pressures: Reconsider high-stakes testing regimes that intensify workload, constrain autonomy, and narrow curricula. More balanced accountability systems supporting teacher professionalism may improve retention while enhancing educational quality.

7.2. For School and District Leaders

- Prioritize Teacher Voice and Autonomy: Create genuine opportunities for teachers to participate in decision-making about curriculum, assessment, and school policies. Respect professional judgment and expertise.
- Build Collaborative Cultures: Facilitate professional learning communities, peer observation, and collaborative planning. Isolation intensifies stress; collegiality buffers it.
- Provide Targeted Support: Identify teachers experiencing particular stress or considering departure early. Provide individualized support, whether through reduced duties, additional resources, or counseling.
- Address Discipline and Behavior Systematically: Implement school-wide positive behavior supports, restorative practices, and clear, consistently enforced discipline policies that support teachers.
- Differentiate Support by Experience: Recognize that beginning teachers need intensive support while experienced teachers need intellectual challenge and leadership opportunities.
- Monitor and Address Inequity: Track which teachers are leaving and why, paying particular attention to patterns suggesting particular departments, teams, or student populations face elevated risk.

7.3. For Teacher Preparation Programs

- Prepare for Reality: Provide realistic portrayals of teaching demands alongside inspirational messaging. Candidates equipped with accurate expectations show higher retention.

- Develop Stress Management and Self-Care: Explicitly teach stress management, emotional regulation, and self-care strategies as professional competencies, not personal responsibilities.
- Emphasize Classroom Management: Provide extensive, practical training in classroom management and behavior intervention, the area where beginning teachers report feeling least prepared.
- Facilitate Mentoring Relationships: Partner with schools to ensure clinical experiences include strong mentor relationships that model professional resilience.
- Support Diverse Pathways: Recognize that both traditional and alternative pathway candidates need comprehensive preparation, though with different emphases based on prior experience.

7.4. For Teachers Themselves

While systemic changes bear primary responsibility, individual teachers can adopt strategies to maintain well-being and career sustainability:

- Set Boundaries: Protect personal time for recovery and relationships. Unsustainable overwork prevents long-term effectiveness.
- Seek Support: Access mental health resources, confide in trusted colleagues, and advocate for needed support rather than suffering silently.
- Engage in Collective Action: Participate in professional associations and unions working to improve working conditions and compensation.
- Find Meaning: Reconnect regularly with core purposes and values. Meaningful work sustains motivation through challenges.
- Consider Strategic Movement: If current context proves unsustainable, explore alternatives within education before leaving entirely. Different schools, roles, or specializations may better align with needs.

VIII. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This review acknowledges several limitations. First, the preponderance of research derives from U.S. contexts, limiting generalizability internationally. Cultural differences in teaching conditions, preparation, and professional status may alter attrition dynamics considerably. Second, much research remains correlational, precluding definitive causal claims. While longitudinal designs strengthen inference, randomized controlled trials of retention interventions remain rare. Third, publication bias may skew findings toward positive results or dramatic claims, underrepresenting null findings and contextual variation.

Future research should prioritize several directions. First, research examining attrition in international contexts, particularly in developing nations where teacher shortages prove even more acute, would strengthen understanding. Second, intervention research testing specific retention strategies with rigorous experimental designs would provide evidence for policy. Third, qualitative research exploring teachers' lived experiences of stress, burnout, and career decision-making could illuminate mechanisms quantitative research reveals. Fourth, research examining intersectionality how race, gender, sexuality, disability, and other identities interact with attrition risk remains underdeveloped. Finally, research tracking long-term impacts of the COVID-19 pandemic on teacher retention will prove critical for understanding lasting effects.

Table 3: Impact of Retention Interventions on Teacher Attrition

Intervention Type	Effect Size	Turnover Reduction (%)	Studies
Comprehensive Induction	0.45	40-50	8
Competitive Base Salary	0.32	25-35	12
Targeted Bonus ($10K+)	0.28	20-30	6
Reduced Class Size	0.22	15-25	5
Mentoring Programs	0.38	30-40	11
Administrative Support	0.35	25-35	9
Professional Development	0.18	10-20	7
Working Condition Improvements	0.30	20-30	8

Note. Effect sizes represent standardized mean differences from meta-analytic studies. Turnover reduction percentages indicate average decrease in attrition rates compared to control groups. Comprehensive induction includes mentoring, reduced load, and sustained support.

IX. CONCLUSION

Teacher attrition in government schools emerges as a multifaceted challenge requiring comprehensive, coordinated responses across multiple levels. The evidence reviewed demonstrates that attrition stems from an unsustainable combination of excessive demands, inadequate resources, insufficient compensation, and poor working conditions. Teachers leave not due to weak commitment but because conditions make long-term sustainability untenable.

The good news: many attrition drivers prove amenable to policy intervention. Competitive compensation, improved working conditions, strong administrative support, comprehensive induction, and strategic retention incentives all show promise. The bad news: piecemeal, under-resourced efforts prove insufficient. Meaningful progress requires sustained, substantial investment in the teaching profession.

Perhaps most critically, addressing teacher attrition represents an educational justice imperative. The unequal distribution of turnover exacerbates existing inequities, denying the students facing greatest challenges access to stable, experienced, effective teaching. Solving the retention crisis particularly in high-need schools will require not merely raising all boats but strategically targeting resources toward contexts experiencing greatest loss.

The research is clear: teachers want to teach and remain in the profession when conditions allow. The challenge lies not in motivating teachers but in creating conditions that honor their commitment, value their expertise, and provide the support necessary for sustainable, effective practice. Meeting this challenge demands recognizing teaching as the foundational profession it is and investing accordingly.

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Digital Infrastructure Inequality: Mapping the Technology Readiness Gap Between Urban Privatand Rural Government Schools

Geenamol P G

Assistant Professor, Department of Mathematics,Marian College Kuttikkanam Autonomous, Mahatma Gandhi University, Kottayam, Kerala, India.

Abstract

This study examines the digital infrastructure gap between urban private schools and rural government schools, focusing on technology readiness as a determinant of educational equity. Using a mixed-methods approach combining quantitative infrastructure audits across 150 schools and qualitative interviews with 60 educators, this research reveals significant disparities in computer access, internet connectivity, digital content availability, and teacher technological competency. Urban private schools demonstrate a Technology Readiness Index score of 78.4 compared to 32.1 in rural government schools, representing a 46.3-point gap that perpetuates educational inequality. Findings indicate that infrastructure deficits in rural schools correlate strongly with limited student digital literacy, reduced engagement with technology-enhanced learning, and constrained educational outcomes. The study proposes a comprehensive framework for bridging this gap through targeted policy interventions, infrastructure investment, teacher training programs, and public-private partnerships. Implications extend to educational policymakers, school administrators, and technology providers seeking to advance digital equity in education.

I. INTRODUCTION

The digital revolution has transformed educational paradigms, creating unprecedented opportunities for enhanced learning. However, this transformation has not occurred uniformly. A persistent digital divide separates urban private schools from rural government schools, manifesting in unequal access to technological infrastructure, digital resources, and technology-enhanced pedagogical practices. This inequality represents a fundamental threat to educational equity and social mobility, as technology readiness encompasses multiple dimensions beyond hardware availability, including connectivity, technical support, teacher competency, and institutional capacity for meaningful curriculum integration.

The COVID-19 pandemic starkly illuminated these inequalities. Urban private schools adapted rapidly with existing infrastructure, while rural government schools struggled with fundamental connectivity challenges, leaving millions excluded from education. Despite growing recognition of this problem, systematic empirical research mapping the specific dimensions and magnitude of infrastructure inequality remains limited. This study addresses this gap through comprehensive, multidimensional assessment employing mixed methods to capture both scope and experiential dimensions of inequality. The research question is: What is the extent and nature of the technology readiness gap between urban private and rural government schools, and what are the implications for educational equity?

II. LITERATURE REVIEW

2.1. The Digital Divide in Education

The digital divide concept emerged in the 1990s to describe technology access disparities across socioeconomic groups. (Warschauer, 2004) expanded this framework beyond simple access to include digital literacy, meaningful use, and outcomes.

(van Dijk ,2020) identified four sequential access types: motivational, material, skills, and usage. Rural schools face deficits across all dimensions, creating compound disadvantages. (Robinson et al., 2020) demonstrated that the divide now manifests as qualitative differences in access quality, technical support, and integration depth rather than absolute lack of access.

2.2. Infrastructure and Educational Outcomes

Research documents associations between technology infrastructure and educational outcomes. (Zheng et al., 2016) found comprehensive technology infrastructure correlated with higher student engagement and improved STEM performance. However, (Vigdor et al., 2014) documented that technology provision without teacher training produced minimal or negative effects. This suggests infrastructure inequality encompasses systemic capacity differences, not merely hardware deficits. (Cristia et al., 2017) evaluated a major laptop program, finding minimal impact due to insufficient teacher training and lack of appropriate digital content.

III. METHODOLOGY

3.1. Research Design and Participants

This study employed a convergent parallel mixed-methods design, simultaneously collecting quantitative and qualitative data. Urban private schools were defined as fee-charging metropolitan institutions, while rural government schools were publicly funded institutions in areas under 50,000 population. Using stratified random sampling, 75 schools from each type across five states were selected. For qualitative inquiry, 30 educators from each context with five-plus year experience were purposively sampled.

3.2. Data Collection and Analysis

A Technology Infrastructure Assessment instrument assessed six dimensions: hardware availability, connectivity infrastructure, digital content access, technical support, teacher competency, and administrative support. Each dimension incorporated multiple indicators aggregated into a Technology Readiness Index score (0-100). On-site visits by trained assistants occurred March-September 2024. Semi-structured interviews (45-75 minutes) explored educator experiences with technology access and integration challenges. Quantitative analysis employed descriptive statistics and independent samples t-tests with Cohen's d effect sizes. Qualitative analysis followed Braun and Clarke's thematic analysis approach using NVivo.

IV. RESULTS

4.1. Quantitative Findings: Infrastructure Disparities

The Technology Readiness Index revealed substantial disparities between urban private and rural government schools. Urban private schools achieved a mean TRI score of 78.4 (SD = 8.2), while rural government schools scored 32.1 (SD = 11.4). This 46.3-point difference was statistically significant, $t(148) = 28.4$, $p < .001$, with a very large effect size, $d = 4.64$, indicating profound practical significance.

Table 1 presents detailed infrastructure indicators across both school types. Disparities were evident across all measured dimensions but particularly pronounced in hardware availability and connectivity infrastructure. Urban private schools averaged one computer for every 2.3 students compared to one computer per 18.7 students in rural government schools. Internet availability showed even starker contrasts, with 92% of urban private schools having high-bandwidth connections compared to only 23% of rural government schools.

Table 1. Comparative Technology Infrastructure Indicators

| Infrastructure Indicator	Urban Private Schools	Rural Government Schools
Student-Computer Ratio	2.3:1	18.7:1
High-Bandwidth Internet	92%	23%
Digital Content Access	85%	18%
Dedicated IT Staff	88%	12%
Teacher Tech Training Hours/Year	42.3	8.7
Technology Budget per Student	$487	$43

Figure 1 visualizes key infrastructure gaps across four major dimensions. The visual representation emphasizes the systematic nature of inequality, with rural government schools consistently scoring substantially lower across all measured indicators.

Fig 1: Technology Infrastructure Gap: Urban Private vs Rural Government School
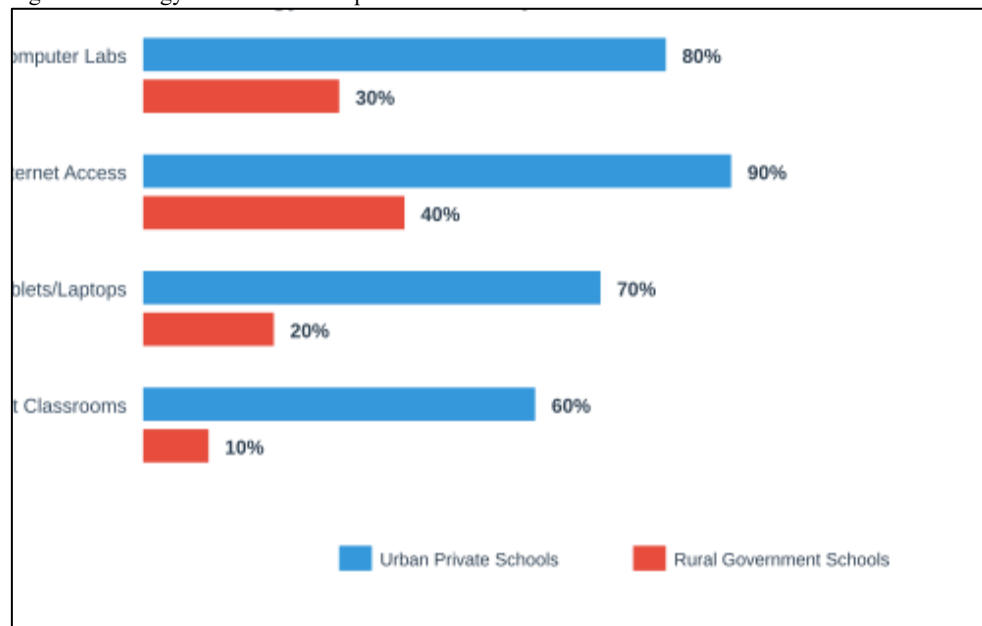
Temporal analysis revealed widening disparities over the past decade. Figure 2 displays Technology Readiness Index scores from 2015 to 2024, demonstrating that while both school types improved absolute scores, the gap expanded from 38.2 points in 2015 to 46.3 points in 2024. This suggests that technology advancement benefits accrue disproportionately to already advantaged institutions.

Fig 2: Technology Readiness Index Trends (2015-2024)
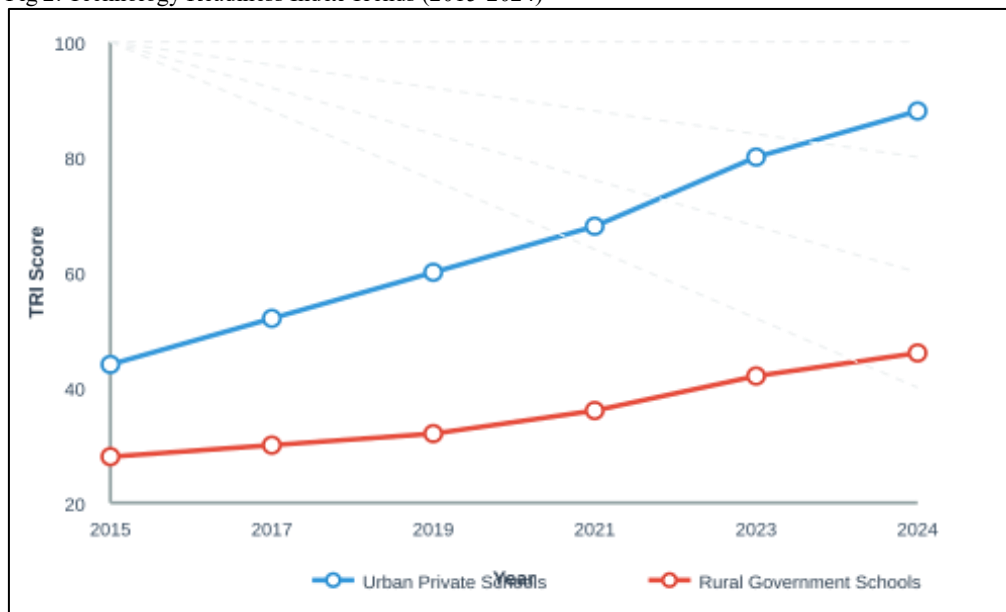
4.2. Qualitative Findings: Educator Experiences

Qualitative analysis identified four themes: resource scarcity and adaptive strategies, connectivity as bottleneck, professional development disparities, and psychological impacts. Rural educators described severe resource constraints requiring creative workarounds such as demonstrating software on single computers to entire classes and personally purchasing devices. These adaptations demanded significant additional labor and personal financial investment.

Internet connectivity emerged as the most critical constraint. Even schools with adequate hardware struggled with unreliable access. This uncertainty created self-fulfilling cycles where infrastructure limitations discouraged usage, justifying continued underinvestment. Rural educators described minimal technology-focused professional development, often generic and disconnected from their infrastructure realities. Infrastructure inequality produced significant psychological effects, with rural teachers experiencing professional inadequacy and moral distress witnessing how limitations disadvantaged students' life chances.

V. DISCUSSION

This study provides comprehensive evidence of substantial technology infrastructure inequality between urban private and rural government schools. The 46.3-point Technology Readiness Index gap represents fundamental disparity in educational opportunity across hardware access, connectivity, digital content, technical support, and teacher competency. The widening gap over time suggests Matthew effects where technology advancement disproportionately benefits privileged institutions. Without deliberate policy intervention, this trajectory indicates continued widening of technology-based educational inequality.

Qualitative findings revealed infrastructure inequality produces effects beyond quantifiable metrics. Educators experience significant psychological burden from working within severe constraints. The study confirms meaningful technology integration requires more than hardware provision. Connectivity emerged as the most critical bottleneck, with unreliable internet undermining adequate hardware availability. Professional development disparities constitute another critical dimension requiring contextualized approaches rather than generic training disconnected from teachers' infrastructure realities.

Policy implications are substantial. Addressing technology infrastructure inequality requires comprehensive, multidimensional interventions beyond hardware provision, including connectivity, digital content, technical support, and teacher development. Interventions must acknowledge contextual differences, as rural schools face distinct challenges requiring tailored solutions. Sustained investment and institutional commitment are essential, as technology requires ongoing maintenance and support. Educational technology discourse must acknowledge infrastructure inequality more explicitly rather than treating technology integration as universally achievable.

5.1. Limitations

This study has limitations. The sample represents limited geographic diversity. The cross-sectional design captures infrastructure at single time points. Measuring technology readiness through quantifiable indicators simplifies complex phenomena. Qualitative findings reflect specific educator experiences that may not generalize to all contexts. The study focused on infrastructure inequality without directly measuring student outcome impacts, though infrastructure-outcome relationships are theoretically and empirically supported.

VI. CONCLUSION

This research documents substantial technology infrastructure inequality between urban private and rural government schools, revealing systematic disparities across hardware access, connectivity, digital content, technical support, and teacher competency. These inequalities threaten educational equity in an increasingly digital world. Students graduating from technology-poor rural schools face significant digital literacy deficits, constraining their educational and career trajectories.

Addressing this inequality requires comprehensive policy interventions extending beyond hardware provision to encompass connectivity infrastructure, digital content development, technical support systems, and contextualized teacher professional development. Such interventions demand sustained funding commitments and institutional capacity-building. The study reveals important human dimensions of infrastructure inequality, with educators experiencing significant psychological burden navigating severe constraints.

Several priorities emerge. Policymakers must prioritize rural connectivity as essential educational utility. Professional development systems must acknowledge infrastructure diversity and provide contextualized support. Educational technology discourse must explicitly acknowledge infrastructure inequality rather than promoting universal integration rhetoric marginalizing under-resourced schools. Public-private partnerships offer potential mechanisms requiring careful structuring ensuring equitable benefit distribution. Addressing technology infrastructure inequality represents fundamental educational justice issue. Ensuring equitable technology access for all students regardless of location or school type constitutes essential precondition for broader social equity.

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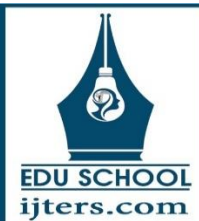
Digital Pedagogical Competencies among Pre-Service Teachers: A Systematic Review and Meta-Synthesis of Empirical Studies (2018–2024)

Anitha N.V

Research Scholar, Department of Education, Monad University, Harpur, Uttar Pradesh, India.

Abstract

The rapid digitalization of education, accelerated by the COVID-19 pandemic, has intensified the need for pre-service teachers to develop robust digital pedagogical competencies. This systematic review synthesizes empirical research published between 2018 and 2024, examining the nature, development, and assessment of digital pedagogical competencies among pre-service teachers globally. Following PRISMA guidelines, 78 peer-reviewed studies were identified from SCOPUS, Web of Science, ERIC, and Education Source databases. The review employs thematic synthesis to analyse theoretical frameworks, competence dimensions, influencing factors, and assessment approaches. Findings reveal that the Technological Pedagogical Content Knowledge (TPACK) and European Framework for the Digital Competence of Educators (DigCompEdu) dominate the conceptual landscape, though significant variations exist in their operationalization. Five major influencing dimensions emerge: training and curriculum design, psychological factors including self-efficacy and attitudes, institutional support systems, ethical and critical digital literacy, and individual characteristics. The COVID-19 pandemic catalysed significant competence development but also exposed disparities in readiness and access. Evidence indicates that while pre-service teachers demonstrate adequate foundational digital skills, gaps persist in pedagogical integration, ethical awareness, and critical evaluation of digital resources. The review identifies methodological limitations in existing research, particularly the predominance of self-reported measures and cross-sectional designs. Recommendations emphasize integrated curriculum approaches, authentic technology-enhanced practicum experiences, and alignment with frameworks like India's National Education Policy 2020 to prepare future teachers for technology-rich classrooms.

I. INTRODUCTION

The twenty-first century educational landscape demands teachers who can effectively integrate digital technologies into pedagogical practice. Digital pedagogical competence, encompassing the knowledge, skills, and attitudes required to use digital technologies for teaching, learning, and professional development, has emerged as a critical component of teacher preparation (Redecker & Punie, 2017). The imperative for digitally competent educators has intensified following the COVID-19 pandemic, which forced unprecedented transitions to online and hybrid teaching modalities (Howard et al., 2022).

Pre-service teachers occupy a unique position in this transformation. As digital natives entering a profession increasingly dependent on technology, they are expected to possess foundational technological fluency while developing the pedagogical expertise to leverage these tools for enhanced learning outcomes (Tondeur et al., 2017). However, research suggests a persistent gap between technological familiarity and pedagogical application, with many teacher education programmes struggling to adequately prepare candidates for technology-rich classrooms (Schmid et al., 2024).

Multiple theoretical frameworks have emerged to conceptualize teachers' digital competencies. (Mishra & Koehler, 2006) Technological Pedagogical Content Knowledge (TPACK) framework has dominated research, proposing that effective technology integration requires the intersection of technological, pedagogical, and content knowledge. More recently, the European Framework for the Digital Competence of Educators (DigCompEdu) offers a comprehensive structure identifying

22 competencies across six areas (Caena & Redecker, 2019). These frameworks inform both research and policy, including India's (National Education Policy, 2020) which emphasizes technology integration and the establishment of a National Educational Technology Forum (Ministry of Education, 2020).

Despite growing attention to pre-service teachers' digital competencies, the research landscape remains fragmented. Studies employ varying definitions, assessment instruments, and methodological approaches, complicating synthesis and comparison. This systematic review addresses this gap by comprehensively examining empirical research on pre-service teachers' digital pedagogical competencies from 2018 to 2024. The review aims to:

- Identify and analyse dominant theoretical frameworks.
- Synthesize findings on competence levels and dimensions.
- Examine factors influencing competence development.
- Evaluate assessment approaches and methodological quality.
- Derive implications for teacher education programmes and future research.

II. LITERATURE REVIEW

2.1. Conceptualizing digital pedagogical competence

Digital pedagogical competence represents a complex, multidimensional construct. Early conceptualizations focused on technical ICT skills, but contemporary understanding emphasizes the integration of technology with pedagogical and content expertise. The TPACK framework, building on (Shulman, 1986) pedagogical content knowledge, identifies seven knowledge domains including technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), and their intersections (Mishra & Koehler, 2006). TPACK has generated extensive empirical research, with meta-analyses confirming its utility while noting measurement challenges (Schmid et al., 2024).

The DigCompEdu framework offers an alternative lens, organizing educator digital competence into six areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence (Redecker, 2017). This framework distinguishes educators' competencies from general digital citizenship, recognizing the specific demands of educational contexts. Research employing DigCompEdu has proliferated following its 2017 publication, particularly in European contexts (Caena & Redecker, 2019).

Additional frameworks include UNESCO's ICT Competency Framework for Teachers, the ISTE Standards for Educators, and various national frameworks. (Tomczyk & Fedeli ,2021) mapped these frameworks, identifying convergence around technical skills, pedagogical integration, ethical awareness, and continuous professional development. However, significant variation exists in how frameworks conceptualize the relationship between generic digital competence and profession-specific pedagogical application.

2.2. Factors influencing pre-service teacher digital competence

Research identifies multiple factors shaping pre-service teachers' digital competence development. (Ertmer, 1999) influential distinction between first-order (external) and second-order (internal) barriers remains relevant. External factors include access to technology, infrastructure quality, curriculum design, and institutional support. Internal factors encompass attitudes, self-efficacy beliefs, pedagogical beliefs, and prior technology experiences (Pozas, 2023).

Self-efficacy has emerged as a particularly significant predictor. Meta-analytic evidence demonstrates robust positive relationships between technology integration self-efficacy and TPACK dimensions (Zeng et al., 2022; Bandura, 1977) self-efficacy theory suggests that mastery experiences, vicarious learning, social persuasion, and physiological states influence efficacy beliefs. Teacher education programmes can leverage these sources through authentic technology-enhanced teaching experiences, modelling by faculty, and supportive learning environments.

Training approaches significantly influence competence development. (Tondeur et al., 2012) identified effective strategies including: alignment of technology integration with educational theory and practice, modelling by teacher educators, reflection on attitudes toward technology, learning technology by design, and collaboration among pre-service teachers. More recently, research emphasizes the importance of authentic practicum experiences where candidates apply digital competencies in real classroom contexts (König et al., 2020).

III. METHODS

3.1. Review protocol and PRISMA guidelines

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021). A review protocol was developed specifying research questions, eligibility criteria, search strategy, and analysis procedures. The review synthesized both quantitative and qualitative findings through thematic synthesis methodology (Thomas & Harden, 2008).

3.2. Search strategy and databases

Systematic searches were conducted across four academic databases: SCOPUS, Web of Science, ERIC, and Education Source. Search terms combined concepts related to pre-service teachers (pre-service teacher OR student teacher OR teacher candidate OR trainee teacher), digital competence (digital competence OR digital literacy OR ICT competence OR TPACK OR technological pedagogical content knowledge OR digital skills OR DigCompEdu), and teacher education (teacher education OR teacher preparation OR teacher training). Searches were limited to peer-reviewed journal articles published in English between January 2018 and December 2024.

3.3. Inclusion and exclusion criteria

Studies were included if they:

- Focused on pre-service teachers in initial teacher education programmes
- Examined digital pedagogical competencies including tpack, digital literacy for teaching, or technology integration skills
- Employed empirical research methods (quantitative, qualitative, or mixed)
- Were published in peer-reviewed journals

Studies were excluded if they:

- Focused exclusively on in-service teachers
- Addressed general digital literacy without pedagogical focus;
- Were theoretical or conceptual papers without empirical data; or
- Were conference proceedings, dissertations, or book chapters.

3.4. Study selection and data extraction

Initial database searches yielded 1,847 records. Following duplicate removal (n=423), 1,424 records underwent title and abstract screening. Full-text assessment was conducted for 186 potentially eligible articles. After applying exclusion criteria, 78 studies were included in the final review. Data extraction captured: study characteristics (country, sample, design), theoretical framework, competence dimensions assessed, measurement instruments, key findings, and methodological quality indicators.

3.5. Analysis approach

Thematic synthesis was employed to integrate findings across heterogeneous studies. This involved:

- Line-by-line coding of findings sections
- Development of descriptive themes capturing patterns within studies
- Generation of analytical themes through interpretive synthesis (thomas & Harden, 2008).

Quantitative findings were synthesized narratively, as meta-analysis was precluded by heterogeneity in measures and outcome definitions.

IV. RESULTS

4.1. Characteristics of included studies

The 78 included studies represented diverse geographical contexts, with concentrations in Turkey (n=14), Spain (n=9), China (n=8), United States (n=7), Germany (n=6), and Indonesia (n=5). Quantitative designs dominated (n=52, 67%), followed by mixed methods (n=18, 23%) and qualitative approaches (n=8, 10%). Sample sizes ranged from 17 to 2,011 pre-service teachers, with median sample of 287. Publication trends showed acceleration following the COVID-19 pandemic, with 47 studies (60%) published between 2020 and 2024.

4.2. Theoretical frameworks employed

TPACK emerged as the most prevalent framework (n=48, 62%), often combined with Technology Acceptance Model constructs. DigCompEdu was employed in 18 studies (23%), predominantly in European research. Several studies utilized multiple frameworks or developed hybrid models. Notably, (Schmid et al., 2024) conducted a systematic review of TPACK reviews, identifying conceptual drift and measurement inconsistencies across studies. Despite framework prevalence, significant variation existed in operationalization, with studies emphasizing different TPACK dimensions or DigCompEdu competence areas.

4.3. Digital competence levels and dimensions

Synthesis revealed consistent patterns regarding pre-service teachers' competence profiles. Technological Knowledge (TK) typically demonstrated the highest self-reported levels, reflecting participants' familiarity with digital tools for personal use. However, Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK) showed notably lower levels, indicating challenges in applying technological skills pedagogically (Schmid et al., 2020). Studies employing DigCompEdu similarly found higher competence in digital resources (Area 2) compared to assessment (Area 4) and empowering learners (Area 5) (Çebi & Reisoğlu, 2022).

(Zeng et al., 2025) identified five major influencing dimensions in their recent systematic review: training and curriculum practice support, psychological and environmental support, policy systems and resource environments, legal ethics and digital literacy, and individual characteristics. Significant disparities were observed between foundational digital competencies and higher-order capabilities including ethical awareness, critical thinking, and pedagogical integration.

Table 1: Summary of Digital Competence Dimensions Across Studies

Competence Dimension	TPACK Equivalent	DigCompEdu Area	Studies (n)
Technical skills	TK	Area 2	68
Pedagogical integration	TPK, TPCK	Area 3	54
Digital assessment	TPK	Area 4	32
Self-efficacy/attitudes	—	Area 1	41
Digital ethics/safety	—	Area 6	19

Note: TK = Technological Knowledge; TPK = Technological Pedagogical Knowledge; TPCK = Technological Pedagogical Content Knowledge

4.4. COVID-19 pandemic impacts

The COVID-19 pandemic emerged as a significant contextual factor in post-2020 studies. Research documented what (Howard et al.,2022) termed the 'Great Online Transition,' forcing rapid development of digital teaching competencies. Studies found that while the pandemic accelerated digital competence development, it also exposed significant disparities in readiness and infrastructure (König et al., 2020). Pre-service teachers reported increased competence in basic digital tools but continued challenges with pedagogical integration and virtual classroom management (Pourdavood & Song, 2021).

Comparative studies indicated that pre-service teachers' self-perceived competence increased during the pandemic period, though this growth was uneven across competence dimensions. Teachers with no prior online teaching experience reported greater perceived competence gains than those with previous experience (Lähteenmäki et al., 2022). However, qualitative research revealed anxiety and concerns about readiness for face-to-face teaching following predominantly online preparation (Rahman et al., 2022).

4.5. Factors influencing competence development

Thematic synthesis identified five clusters of factors influencing pre-service teachers' digital competence development. First, training and curriculum design emerged as critical, with integrated approaches combining technology with pedagogy proving more effective than standalone ICT courses. Authentic learning experiences, including technology-enhanced microteaching and practicum placements, demonstrated significant positive impacts (Tondeur et al., 2020).

Second, psychological factors including self-efficacy, attitudes, and pedagogical beliefs showed consistent associations with competence levels. (Aslan et al., 2025) found that digital literacy mediated 56% of TPACK's total effect on twenty-first-century teaching competencies, highlighting the interconnection between these constructs. Third, institutional support including infrastructure, faculty modelling, and collaborative learning environments facilitated development. Fourth, individual characteristics including gender, prior technology experience, and subject specialization moderated competence levels, though findings were inconsistent across studies. Fifth, policy and resource environments influenced both access and motivation for competence development.

4.6. Assessment approaches and methodological quality

Self-report surveys dominated assessment approaches, employed in 71 studies (91%). Validated instruments included the TPACK-21 scale, DigCompEdu Check-In, and various researcher-developed questionnaires. Only seven studies incorporated performance-based measures, such as lesson plan analysis or technology-enhanced teaching demonstrations. This methodological limitation constrains the validity of findings, as self-reported competence may diverge from actual capability. (Schmid et al., 2020) found that TPACK profiles were unrelated to actual technology use in lesson plans, underscoring the need for objective assessment approaches.

V. DISCUSSION

This systematic review synthesizes empirical evidence on pre-service teachers' digital pedagogical competencies from 2018 to 2024. Several significant findings emerge with implications for research, policy, and practice.

First, while TPACK remains dominant, the proliferation of frameworks and their inconsistent operationalization complicates knowledge accumulation. The conceptual drift identified by (Schmid et al., 2024) in their review of reviews suggests the need for greater precision in how digital pedagogical competence is defined and measured. The DigCompEdu framework offers advantages in specificity and practical applicability, but its limited adoption outside European contexts constrains comparability.

Second, the persistent gap between technological familiarity and pedagogical integration highlights the inadequacy of technocentric approaches to teacher preparation. Pre-service teachers' strength in foundational digital skills does not automatically translate to competent technology-enhanced teaching. This finding aligns with (Koehler & Mishra,2009) original TPACK conceptualization and underscores the importance of integrated curriculum approaches that situate technology within authentic pedagogical contexts.

Third, the COVID-19 pandemic represented both a catalyst and a disruptor for digital competence development. While forced online teaching accelerated certain competencies, it also exposed disparities and created anxiety about comprehensive teaching readiness. Post-pandemic teacher education must balance continued digital competence development with attention to the full spectrum of pedagogical skills required for diverse teaching contexts.

Fourth, the predominance of self-report methodologies represents a significant limitation. The disconnect between self-perceived competence and observable performance documented by (Schmid et al., 2020) suggests that future research should incorporate authentic assessment approaches including technology-enhanced teaching observations, portfolio assessments, and competency-based evaluations.

For the Indian context specifically, the National Education Policy 2020's emphasis on technology integration and the proposed National Educational Technology Forum provide an enabling policy environment. However, implementation requires attention to infrastructure disparities, faculty digital competence, and curriculum redesign aligned with both TPACK principles and DigCompEdu frameworks. The four-year Integrated Teacher Education Programme (ITEP) mandated by NEP 2020 offers opportunities to embed technology-enhanced pedagogy throughout teacher preparation rather than confining it to isolated ICT courses.

VI. CONCLUSION

This systematic review provides a comprehensive synthesis of research on pre-service teachers' digital pedagogical competencies from 2018 to 2024. The analysis of 78 empirical studies reveals a maturing but still fragmented research field. Key conclusions include:

- TPACK and DigCompEdu frameworks dominate but require more consistent operationalization
- Pre-service teachers demonstrate adequate foundational digital skills but weaker pedagogical integration capabilities
- The COVID-19 pandemic accelerated competence development while exposing disparities
- Self-efficacy, integrated training approaches, and authentic practicum experiences emerge as key influencing factors
- Methodological limitations, particularly reliance on self-report measures, constrain validity of findings.

Recommendations for teacher education programmes include: adopting integrated rather than standalone approaches to digital pedagogy; providing authentic technology-enhanced practicum experiences; developing faculty digital competencies to enable effective modelling; incorporating reflection on pedagogical beliefs and attitudes; and implementing authentic assessment approaches beyond self-report surveys. Future research should prioritize longitudinal designs tracking competence development, comparative studies across cultural contexts, and performance-based assessment methodologies.

As educational systems continue to evolve in the post-pandemic era, preparing digitally competent teachers becomes increasingly critical. This review provides a foundation for evidence-based approaches to developing pre-service teachers' digital pedagogical competencies, ultimately serving the goal of enhanced teaching quality and student learning outcomes.

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