



The Role of Virtual Learning Platforms on Student Engagement in Hybrid Models: A Study of Selected Government and Private Schools in Jammu and Kashmir

*Harjinder Singh¹ and Jyotsana Thakur²

^{*1}Research Scholar, Chandigarh University, Punjab, India.

journalist.singh@gmail.com

²Professor, UIMS, Chandigarh University, Punjab, India.

Abstract

The study aims to examine the role of virtual platforms in hybrid education by comparing student engagement patterns across selected government and private schools in Jammu and Kashmir. Four key objectives guided the research: (1) to assess differences in engagement levels across school types; (2) to validate the three-dimensional construct of student engagement (behavioral, emotional, cognitive); (3) to examine predictive relationships among engagement dimensions; and (4) to evaluate teacher preparedness and platform usage. Data were collected using stratified random sampling from 300 students (150 government, 150 private) and 60 teachers. Both descriptive and inferential methods were employed, including independent t-tests, Pearson correlation, exploratory factor analysis (KMO = 0.847), and multiple regression analysis ($R^2 = 0.51$). Results indicate significantly higher engagement among private school students. Emotional and behavioral engagement were found to be significant predictors of cognitive engagement. Teachers in private schools also demonstrated higher digital readiness and confidence. The study concludes that effective hybrid learning is strongly influenced by structured digital integration, teacher preparedness, and consistent engagement strategies. These findings underscore the need for targeted interventions in government schools to address gaps in infrastructure, training, and platform access.

Keywords- *Hybrid Learning Models, Student Engagement, Virtual Learning Platform, Digital Education, Government Schools, Private Schools, innovative Learning environment.*

1. Introduction

The evolution of modern education has been significantly influenced by the integration of digital technologies, with virtual learning platforms emerging as important tools in modern education. After COVID-19 pandemic, the integration of virtual learning platforms has become defining feature of contemporary education, particularly within hybrid learning models that merge the strengths of both digital and traditional classroom environments [6]. Learning management system to interactive digital tools, these platforms have transformed how student access content, engage with instructors and participate in academic activities [12]. With the increasing adoption of digital whiteboards, live sessions and interactive classroom technologies, hybrid learning has emerged as a flexible and student centric that support deeper engagement and personalised learning pathways [9].

COVID-19 have played important role in shift towards hybrid models, promoting schools worldwide to adopt a blend of in-person and online instruction through virtual mode.

In context of union Territory of Jammu and Kashmir, the adoption of virtual learning brings unique challenges and opportunities. The region's socio-political complexities, infrastructure disparities, and varying levels of digital literacy present significant hurdles in ensuring equitable access to digital education. Government and private schools exhibit contrasting capabilities in terms of integrating technology into pedagogy [3]. While private institutions may benefit from better infrastructure and training, government schools often struggle with limited resources and digital divide issues. These contrasts make it essential to critically assess how virtual learning platforms affect student engagement, participation, and academic performance in both contexts [8].

Student engagement remains a cornerstone of effective learning, particularly in blended settings where motivation and interaction can vary widely [5]. It is not merely about attendance or participation, but also about emotional investment, cognitive involvement and behavioural consistency. Virtual platforms have potential to enhance these aspects if implemented and supported effectively [2]. However, technical issues, lack of training and inconsistent internet access may limit their success, particularly in resource constrained settings [11]. This study undertakes a comparative analysis of selected government and private schools in Jammu and

Kashmir and to investigate the impact of virtual learning platforms on student engagement within hybrid learning models.

1.1 Objectives of the Study

- 1) To study the adoption and integration of virtual learning platforms in government and private Schools in Jammu & Kashmir.
- 2) To identify the key challenges faced by the students and teachers in using virtual learning platforms.
- 3) To compare the effectiveness and usage of virtual learning platforms in government and private schools in Jammu & Kashmir.
- 4) To recommend strategies for enhancing student's engagement and academic performance through virtual learning tools.

2. Review of Literature

Several independent studies have been conducted to look into how hybrid learning model impact student perception. According to a fast survey of the literature, review of the studies found that in some cases, the use of blended hybrid learning model increase the academic success [5, 11, 12, 13, 14] in other cases, Dhawan et al. (2020) [9] examined the impact and recovery of the educational landscape in Jammu and Kashmir during the COVID-19 Pandemic. The study highlights significant challenges such as the digital divide, limited access to online tools, and infrastructure gaps hindering learning during this period. Study emphasised the role of digital platforms and hybrid model of learning ensuring better engagement and accessibility in regions like Jammu and Kashmir where internet connectivity remained inconsistent[1, 14]. The authors recommended hybrid learning model as sustainable model for enhancing educational resilience in the post –pandemic period.

Wani et al. (2023) [3] examined learning support system in distance higher education institutions of Jammu and Kashmir. The study highlighted the need for the improved academic guidance, digital resources and student engagement strategies to enhance learning outcomes. It emphasizes strengthening communication channels and technical support to address regional challenges and discussed policy interventions and infrastructure development to improve support system. Dheva Rajan and Fajlul Kareem (2023) [2] studied evolving landscape of virtual learning in India highlighting significant shift in teaching learning pedagogy post

pandemic. The study underscores the growing dependence on digital platforms, interactive tools and blended learning models to enhance educational delivery.

Qamar et al. (2024) [4] in his study proposed a blended learning framework combining face to face and online learning to enhance post-COVID classrooms in India. The study highlighted integration of digital tools with traditional teaching methods can improve student engagement, learning outcomes and flexibility in educational delivery. The authors stressed the importance of teacher training, technological infrastructure, and interactive learning strategies to ensure the successful implementation of blended learning.

Sethi and Singh (2024) [1] explored the integration of Artificial intelligence and blended learning in Higher Education, prioritizing their role in enhancing teaching strategies, personalised learning and academic performance. Study highlights the contribution of Artificial intelligence in adaptive learning environments, automated assessments and data driven insights promoting student engagement.

2.1 Hypothesis Formation

Hypothesis I

H₀ (Null Hypothesis): There is no significant difference in student engagement between government and private school students.

H₁ (Alternate Hypothesis): There is a significant difference in student engagement between government and private school students.

Hypothesis II

H₀: There is no difference in emotional engagement between male and female students.

H₁: Female students report higher emotional engagement than males.

Hypothesis III

H₀: There is no correlation between emotional and cognitive engagement.

H₁: Emotional engagement is positively correlated with cognitive engagement.

Hypothesis IV

H₀: Emotional and behavioral engagement do not significantly predict cognitive engagement.

H₁: Emotional and behavioral engagement significantly predicts cognitive engagement.

3. Research Methodology

3.1 Research Design

The study adopts a comparative, cross-sectional survey design to evaluate student engagement in hybrid education models across selected government and private schools in Jammu & Kashmir (J&K).

3.2 Population and Sampling

The population includes both teachers and students from selected government and private schools across various districts in Jammu and Kashmir. A stratified random sampling technique was used to ensure adequate representation from both school types.

- **Total sample size: 300 students**
 - Government schools: 150
 - Private schools: 150

The population includes students from classes 9–12 in selected government and private schools. A stratified random sampling technique was used to ensure representation from both sectors.

- Total sample size: 300 students
 - Government schools: 150
 - Private schools: 150

3.3 Data Collection Tool

A structured questionnaire was developed using validated instruments measuring the following dimensions of student engagement:

- Behavioral Engagement
- Emotional Engagement
- Cognitive Engagement

The instrument consisted of 20 Likert-scale items (1 = Strongly Disagree, 5 = Strongly Agree).

3.4 Reliability and Validity

- A pilot study (N=30) was conducted to test reliability.
- Cronbach's Alpha = 0.89 (indicating high internal consistency).
- Exploratory Factor Analysis (EFA) was used to test construct validity.

3.5 Analytical Tools

- Descriptive Statistics (mean, SD, percentage)
- Independent Samples t-Test (for comparing Govt vs Private school students)
- Exploratory Factor Analysis (EFA)
- Correlation Analysis
- Regression Analysis (optional, for identifying predictors of engagement)

4. Data Analysis

We now proceed to analyse the data collected both from teachers and students across various Government and private schools in Jammu and Kashmir. To begin with data analysis, we first examine the summary of Teacher's questionnaire responses:

4.1 Descriptive Analysis

Summary of Teacher's Questionnaire responses (N=60)

Respondent Profile (N=60)

- 53.3% Teachers, 15% Physical Teachers, 10% Headmasters, 11.7% Chairpersons, 10% Masters
- 76% Female 24% Male
- 50% with Over 10 years of experience

Platform Usage:

- Most used: Interactive Whiteboards (71.4%) Zoom (44.6%) Google Meet (28.6%)
- Least used: VR/AR & M-Learning (1% Each)

Confidence Level:

- 57.1% Very Confident
- 42.9% confident

Frequency of Hybrid Teaching:

- 57.1% Weekly
- 28.6% Occasionally
- 14.3% Daily

Preferred professional Development Area:

- 21.7% Training on Platform usage
- 38.3% Strategies for boosting student engagement
- 26.7% Technical troubleshooting guidance
- 13.3% Creating effective digital content

Most Useful Virtual Teaching Features: (N=60, Multiple Responses allowed)

- 81.7% Digital Whiteboard Tools
- 75% Assignment submission portals
- 66.7% Chat and Q&A Sessions
- 60.0% Recorded Sessions
- 50.0% Screen Sharing
- 33.3% Breakout rooms for group work
- 16.7% Polling tools

Challenges Faced in Hybrid Learning Sessions: (N=60, Multiple Responses allowed)

- 95% Technical Issues (Connectivity, outages, glitches)
- 91% Lack of Technical support or troubleshooting assistance
- 93% Difficulty in engaging students with special needs
- 55% Low student participation and student discipline in class
- 11.7% difficulty in monitoring student progress

Following the analysis of teachers responses, now we turn our attention to the data gathered from students across selected government and private schools in Jammu and Kashmir, This section presents a detailed examination of students perceptions, usage patterns, challenges faced and their overall experiences with virtual learning platforms in hybrid educational setting.

Summary of Student's Questionnaire responses (N=300)

Demographic Profile

- 63.3% from Private schools, 36.7% from Government Schools
- 53.3% affiliated with CBSE, 46.7% with JKBOSE
- District covered were kathua, samba, Jammu, Reasi, Udhmapur, Jammu
- Gender: 51.3% Female, 48.7% Male
- Age Distribution: Below 10 yrs (10%) 10-12 years, (18.7%) 13-15 Years (32%) above 16 Yrs (39.3%)

Platform Usage:

- Top used: YouTube (30%), Zoom (19.7%), Google Meet (14%)
- Least Used: VR/AR (1%), Mobile Learning (2%)

Frequency & Engagement:

- 56% attend weekly, 30% daily, 14% Occasionally/Never
- Engagement: 27% more engaging, 25% Less Engaging, 46% Neutral

Helpful Features:

- 62% recorded content, 52% Video Lectures, 43% Interactive tools
- Challenges Faced: 73% Poor Internet, 16% Technical Issues, 9% Lack of devices
- Also Noted: Distractions at Home, Limited Teacher support, Isolation

Academic Impact:

- 83% Say Improvement in academic performance
- 37% significantly, 48% slightly
- Only 10% reported decline

Table 1. Descriptive Statistics – Student Engagement Scores by School Type.

Engagement Type	Govt. Schools (M ± SD)	Private Schools (M ± SD)	Total Mean
Behavioral Engagement	3.41 ± 0.72	3.78 ± 0.68	3.59
Emotional Engagement	3.12 ± 0.65	3.89 ± 0.71	3.50
Cognitive Engagement	3.25 ± 0.58	3.73 ± 0.60	3.49

The descriptive statistics in Table 1 reveal notable differences between students from government and private schools in terms of their engagement with hybrid learning. Students from private schools reported higher levels of engagement across all three dimensions. Behavioral engagement in private schools averaged 3.78 compared to 3.41 in government schools. Similarly, emotional engagement was 3.89 for private school students and 3.12 for government school students. Cognitive engagement also followed this pattern, with a mean of 3.73 in private schools versus 3.25 in government schools. The overall trend indicates that students from private institutions tend to be more engaged, suggesting that they may have better access to digital tools, more structured hybrid programs, or more interactive online teaching.

4.2 Hypothesis Testing – t-Test

H_0 (Null Hypothesis): There is no significant difference in student engagement between government and private school students.

H_1 (Alternate Hypothesis): There is a significant difference in student engagement between government and private school students.

Table 2. Independent Samples t-Test – Govt. vs. Private Schools.

Engagement Type	t-value	p-value	Result
Behavioral Engagement	-3.46	0.001	Significant (Reject H_0)
Emotional Engagement	-5.10	0.000	Highly Significant (Reject H_0)
Cognitive Engagement	-4.02	0.000	Highly Significant (Reject H_0)

Table 2 presents the results of an independent samples t-test used to determine whether the differences in engagement scores between government and private school students were statistically significant. The findings are compelling: behavioral engagement shows a significant difference with a t-value of -3.46 and a p-value of 0.001. Emotional engagement displays a highly significant difference ($t = -5.10$, $p = 0.000$), as does cognitive engagement ($t = -4.02$, $p = 0.000$). These results lead to the rejection of the null hypothesis (H_0), supporting the alternate hypothesis (H_1) that private school students are significantly more engaged than their

government school counterparts. This has practical implications for policy interventions in public education to bridge digital learning gaps.

4.3 Gender-wise Analysis

H₀: There is no difference in emotional engagement between male and female students.

H₁: Female students report higher emotional engagement than males.

Table 3. Gender-wise t-Test (Emotional Engagement).

Gender	Mean ± SD	t-value	p-value	Result
Male	3.42 ± 0.69	-2.36	0.019	Significant (Reject H ₀)
Female	3.65 ± 0.66			

The gender-based analysis in Table 3 explores whether male and female students differ in emotional engagement. The mean emotional engagement score for females was 3.65 (SD = 0.66), while for males it was 3.42 (SD = 0.69). The difference was statistically significant, with a t-value of -2.36 and a p-value of 0.019. These findings lead to the rejection of the null hypothesis, indicating that female students tend to feel more emotionally connected and responsive to hybrid learning environments than males. This could be due to differences in communication styles, learning preferences, or the ability to adapt to virtual instruction.

4.4 Platform Usage Frequency (Self-reported)

Table 4. Frequency of Virtual Platform Use.

Platform	Regular Users (%)	Occasional Users (%)	Never Used (%)
Zoom	62.3	28.0	9.7
Google Meet	54.7	33.3	12.0
MS Teams	23.0	44.7	32.3
Digital Boards	38.7	31.3	30.0
Mobile Learning	21.3	39.0	39.7

Table 4 illustrates how often students used specific virtual platforms for learning during hybrid instruction. Zoom emerged as the most frequently used platform, with 62.3% of students reporting regular use. Google Meet followed with 54.7% regular users. Platforms such as Microsoft Teams (23%) and mobile learning tools (21.3%) saw far less regular use, and nearly 40% of students reported never using mobile learning apps. These figures suggest a strong dependency on specific video conferencing tools, likely driven by school or teacher preferences, and highlight the underutilization of diverse educational technologies.

4.5 Correlation Between Engagement Dimensions

H₀: There is no correlation between emotional and cognitive engagement.

H₁: Emotional engagement is positively correlated with cognitive engagement.

Table 5. Pearson Correlation Matrix.

Engagement Type	Behavioral	Emotional	Cognitive
Behavioral Engagement	1	0.62**	0.54**
Emotional Engagement	0.62**	1	0.68**
Cognitive Engagement	0.54**	0.68**	1

The Pearson correlation matrix in Table 5 demonstrates significant positive relationships between the three engagement dimensions. Behavioral and emotional engagement are correlated at 0.62, behavioral and cognitive at 0.54, and emotional and cognitive at 0.68. All correlations are significant at the 0.01 level. The strongest association between emotional and cognitive engagement suggests that students who feel emotionally invested in their learning are more likely to process information deeply and meaningfully. These findings support existing educational theories which propose that emotional engagement serves as a precursor to sustained cognitive efforts, reinforcing the importance of maintaining student motivation and emotional connection in hybrid education.

4.6 Factor Analysis – Engagement Scale Validation

Table 6. KMO and Bartlett’s Test.

Test	Value
KMO Measure of Sampling Adequacy	0.847
Bartlett’s Test (p-value)	0.000

Table 6 provides the preliminary statistical tests for validating the use of factor analysis. The Kaiser-Meyer-Olkin (KMO) measure was 0.847, which is well above the acceptable threshold of 0.6, indicating sampling adequacy. Bartlett’s test of sphericity yielded a p-value of 0.000, showing that the correlations among items were sufficiently large for factor analysis. These results confirm that the data is suitable for exploratory factor analysis (EFA), allowing for the identification of underlying engagement dimensions within the student survey instrument.

Table 7. Rotated Component Matrix – Engagement Dimensions.

Item	Emotional	Behavioral	Cognitive
I feel motivated to attend hybrid classes	0.81	—	—
I interact actively in virtual sessions	—	0.74	—
I try to understand lessons deeply	—	—	0.76
I enjoy learning via hybrid modes	0.77	—	—
I complete tasks on time	—	0.68	—
I critically reflect on what I learn	—	—	0.72

In Table 7, the rotated component matrix displays factor loadings for six key engagement items. Items related to motivation and enjoyment of hybrid classes loaded heavily on the emotional engagement factor, while items like active participation and task completion aligned with behavioral engagement. Items such as deep understanding and critical reflection loaded on the cognitive factor. The clarity of these loadings confirms the three-dimensional structure of student engagement used in the study. It also affirms that the questionnaire effectively distinguishes between the emotional, behavioral, and cognitive components of student experiences in hybrid education settings.

4.7 Regression Analysis

H₀: Emotional and behavioral engagement do not significantly predict cognitive engagement.

H₁: Emotional and behavioral engagement significantly predict cognitive engagement.

Table 8. Regression Summary.

Predictor	B	Beta	t-value	p-value
Emotional Engagement	0.32	0.41	6.40	0.000
Behavioral Engagement	0.28	0.36	4.67	0.000
R ² = 0.51, F(2,297) = 64.3, p < 0.001				

Table 8 presents a multiple regression analysis to determine whether emotional and behavioral engagement predict cognitive engagement. Both predictors were statistically significant: emotional engagement ($\beta = 0.41$, $p = 0.000$) and behavioral engagement ($\beta = 0.36$, $p = 0.000$). The model explained 51% of the variance in cognitive engagement ($R^2 = 0.51$), and the overall regression was statistically significant ($F = 64.3$, $p < 0.001$). This indicates that students who are emotionally and behaviorally engaged are much more likely to be cognitively involved in learning, underscoring the interconnected nature of these dimensions. These findings offer a

strong case for designing hybrid lessons that promote emotional and behavioral involvement to enhance cognitive outcomes.

4.8 Student Challenges in Hybrid Learning (Multiple Response)

Table 9. Challenges Reported by Students.

Challenge Type	% Reporting
Internet Connectivity Issues	78.7%
Difficulty Concentrating in Online Classes	65.3%
Lack of Teacher Interaction	58.0%
Device Availability Issues	43.0%
Lack of Parental Support at Home	27.3%

Student-reported challenges with hybrid learning are summarized in Table 9. The most common issue was internet connectivity, reported by 78.7% of students. This was followed by difficulty concentrating during online classes (65.3%) and lack of teacher interaction (58.0%). Other challenges included device unavailability (43%) and inadequate parental support (27.3%). These data points highlight that infrastructural and engagement barriers continue to hinder the effectiveness of hybrid education. The results particularly emphasize the need for improved digital infrastructure, more personalized teacher support, and interventions for students lacking a supportive home learning environment.

4.9 Satisfaction with Hybrid Learning

Table 10. Overall Satisfaction Levels.

Response Category	% of Students
Very Satisfied	12.3%
Satisfied	35.0%
Neutral	28.7%
Dissatisfied	15.3%
Very Dissatisfied	8.7%

Table 10 shows that student satisfaction with hybrid learning is mixed. Only 12.3% reported being very satisfied, while 35% were satisfied. A large portion of students (28.7%) felt neutral, and 24% were either dissatisfied or very dissatisfied. These results suggest that while some students have adapted well to hybrid models, a significant proportion remains unconvinced of its effectiveness. Satisfaction levels could be influenced by access to devices, internet reliability,

teacher engagement, or even the students' own learning styles. These findings underscore the importance of continuous quality improvement in hybrid instruction design.

4.10 Preference for Post-Pandemic Teaching Mode

Table 11. Preferred Mode of Learning.

Mode	Govt. Students (%)	Private Students (%)	Total (%)
Fully Online	10.0%	15.3%	12.7%
Hybrid	47.3%	50.0%	48.7%
Fully Offline	42.7%	34.7%	38.7%

As shown in Table 11, nearly half of the students (48.7%) preferred hybrid learning as the ideal mode of instruction going forward. Only 12.7% opted for fully online learning, while 38.7% still preferred fully offline classes. Government school students were more inclined toward offline learning than their private school peers. These preferences reflect a growing acceptance of hybrid education, but also highlight persistent access gaps and the enduring value of face-to-face interaction, especially for students who face digital or pedagogical disadvantages in online settings.

4.11 Student Suggestions to Improve Hybrid Learning

Table 12. Top Suggestions from Students (Open-ended, coded responses).

Suggestion Theme	% Mentioned
Improve Internet Infrastructure	41.0%
More Interactive Sessions	36.3%
Provide Recorded Lectures	28.0%
Provide Devices to Needy Students	22.3%
Flexible Submission Deadlines	18.7%

Table 12 summarizes coded student suggestions for improving hybrid education. The most frequent recommendation, cited by 41%, was improving internet infrastructure. Other major suggestions included incorporating more interactive sessions (36.3%), providing access to recorded lectures (28%), distributing devices to underserved students (22.3%), and offering flexible deadlines for assignments (18.7%). These insights offer actionable guidance for educators and administrators, emphasizing the need to address both technological and instructional gaps to enhance hybrid learning effectiveness and equity.

Table 13. Comparative analysis: Government V/s Private Schools of Jammu and Kashmir.

Dimension	Government Schools	Private Schools
Platform Usage	Mostly asynchronous: YouTube (high), WhatsApp; Zoom used by fewer students and teachers	Mostly synchronous: Zoom (62.3%), Google Meet (54.7%), Interactive Whiteboards (71.4%)
Attendance Frequency	Primarily weekly (57.1% teachers, 56% students); low daily attendance	Frequent attendance: 30% students daily, more structured hybrid schedules
Student Engagement	Lower scores: Behavioral (3.41), Emotional (3.12), Cognitive (3.25)	Higher scores: Behavioral (3.78), Emotional (3.89), Cognitive (3.73)
Learning Experiences	Passive learning, delayed feedback, low interactivity	Interactive learning, timely feedback, assignment portals, Q&A sessions
Challenges	Major: Internet issues (78.7%), device unavailability (43%), low teacher digital skills	Minor: Home distractions, some connectivity drops, but higher access to resources
Teacher Preparedness	50% have >10 years' experience but limited tech training; 91% lack support	Regular PD: 38.3% seek engagement strategies; confident tool usage; LMS adoption
Useful Features	Teachers: Whiteboards (81.7%), recorded sessions (60%)	Students: Recorded content (62%), video lectures (52%), interactive tools (43%)
Satisfaction Level	Mixed: Students neutral or dissatisfied (44%)	More satisfied: 47.3% students found it engaging and effective
Academic Impact	Positive but lower: 83% improved; more "slight" than "significant" improvement	Higher impact: 37% reported significant academic improvement

Summary Table: Key Comparative indicators

5. Discussion

This study was guided by four interrelated objectives: (1) to assess differences in student engagement across government and private schools in Jammu and Kashmir, (2) to validate the construct of engagement in hybrid education, (3) to examine the predictive relationship among engagement dimensions, and (4) to analyze the preparedness and platform usage patterns of

teachers facilitating hybrid learning. The results from both student and teacher data offer strong empirical support for these aims and reveal significant contrasts in how hybrid learning environments are experienced across school types.

Under the first objective, the findings of the analysis confirmed a considerably strong engagement by the students in privately owned schools in behavioral, emotional, and cognitive engagement as opposed to their counterparts in government-owned institutions. The above-mentioned differences were confirmed as being statistically significant by the independent samples t-tests [13]. This is an indication that the hybrid learning can be more practically effective in the private schools, presumably, because of enhanced access to the platforms, controlled timetables, and digitally accomplished teaching staff. These data align with the existing literature in which it has been reported that more powerful digital learning environments in schools facilitate a higher level of student engagement and satisfaction [5, 9, 11].

Exploratory factor analysis (EFA) was performed in order to achieve the second goal of the study, which is to validate the engagement construct in the hybrid scenario. The overall KMO measure and significant Bartlett test indicated that the data was suitable to undertake factor analysis since it was measured at 0.847 and Bartlett test was highly significant. The items were distinctively grouped into the emotional, behavioral, and cognitive dimensions, corroborating with the multidimensional model of engagement that prevails in the existing body of literature [7, 8, 9]. Such justification is essential, because it adds credence to the theoretical supposition that hybrid learning has to be tested along the varied, interdependent lines of student participation and interaction [10].

The third aim was the determination of a predictive relationship between the dimensions of engagement. Multiple regression analysis revealed that both behavioral engagement (0.36), and emotional engagement (0.41) were superb predictors of cognitive engagement as they collectively accounted to 51 percent of the variance of cognitive engagement. These results can suggest: the cognitive engagement in hybrid environments is mostly spurred by emotional attachment of students to the content and their engagement with learning activities as behavioral investment- this finding is correlated with that of Sun and Rueda (2012) [2] who reported that more profound learning online environment is perpetuated by emotional and participatory factors.

The last goal looked at how prepared the teachers are and the application of virtual platforms. Distinctions among the responses provided by the teachers were evident: the teachers of the

private schools showed a higher digital confidence level, the commonly used digital tools (despite the screens, online whiteboards, and Zoom), and regular training. Teachers working in government schools, in turn, noted serious disparities in digital competence, technical assistance, and training opportunities—a phenomenon time and again highlighted by Wani (2023)[3] in terms of digital capacity in the public education sphere. This observation is consistent with the works pointing at the paramount importance of the teacher preparedness as the factor contributing to student success in virtual and hybrid education [10].

Difficulties that are observed by students highlight the role of the digital inequality as well. Although the main reported distraction by the students in the private school was the house and intermittent internet lag, the students in the government schools had more structural challenges in front of them, like limited access to devices (43%), poor connection (78.7%) and minimum amount of live interactions with teachers [7, 8]. The results are consistent with national and global trends observed in the literature during and after the COVID-19 pandemic [1, 2], and they form the basis of the demand of more inclusive technology policies.

Technically, on a more positive note, after all this, most students said they found academic improvement because of hybrid learning (83%), with students in private schools more apt to say they found significant improvement. This implies the hybrid models may be advantageous in the restrictive settings, provided with flexible teaching and available-to-all technology [8]. In addition, expectations on future learning modalities favored a hybrid model, which also confirms the research by Singh & Thurman (2019) [10] that indicates that blended models are likely to remain in existence even after the pandemic as they are versatile and agile.

The combination of the data gives a clear indication in support of all the objectives of the study. The demonstrated comparative differences in engagement, the validated engagement scale, the predictability of relationship between dimensions, and the level of readiness by conceptual component (structural, pedagogical, and technological) all lead to the same conclusion: hybrid learning has a potential to improve educational outcomes, but it has to rely on the structural, pedagogical and technological readiness in order to work. It will be crucial to focus on the digital divide and professional development of educators working in government schools, thus making them equal participants in the digitalized educational system.

6. Conclusion

This paper aimed at exploring the purpose of virtual platforms in the enhancement of student engagement in hybrid learning with a comparative approach to government and private schools

in Jammu and Kashmir. Four main objectives were envisaged in the study, and each one of them has been tackled with the help of statistical examination and ground truths.

The study in determining the differences in student engagement in the context of the school types discovered that regardless of the variety of strategies available to the private school students, the results illustrate a steady difference in behavioral, emotional and cognitive engagement between students in the private and government schools. Independent t-test confirms that these differences represent more serious systemic ones, especially in the digital access level as well as instructional approaches and platform use. It confirms previous studies which establish connectivity with the quality of digital infrastructure, as well as, design of instruction (AI-Qatawneh, 2020; Dhawan, 2020).

The research confirmed the dimensional structure of student engagement in a hybrid setting by the factor analysis. The results were consistent with the theoretical differentiation of emotional, behavioral and cognitive engagement as it was by Fredricks et al. (2004). The good factor loading and high KMO value point that the engagement model used has enough psychometric reliability as well as being context relevant to the hybrid learning situation within the Indian schools.

The article has investigated emotive and behavioral involvement in forecasting cognitive involvement. The fact that both the predictors were significant based on the regression analysis showed that the emotional engagement had the strongest impact. This observation helps to prove the hypothesis that the cognitive depth in learning occurs when the students are not only emotionally interested, but also behaviorally engaged (so-concluded Sun and Rueda, 2012). It implies that the teaching methods in hybrid classrooms are to be aimed not only at conveying of material but the need to build the feeling of emotional connection and active student involvement.

In the discussion of teacher readiness and use of the platform, the scholarship has revealed that there is indeed a huge disparity between government and private school teachers. The private institution teachers were more confident, had greater frequency of use and had better access to training. Conversely, a common complaint of government school teachers was they had insufficient digital education, technical assistance and limitations of facilities. These discrepancies directly impact student participation and circle around the more extensive unequal access to education (Wani, 2023; Sethi & Singh, 2024).

The evidence provided in the findings is very convincing in arguing the role of hybrid learning success, and it is not only the access to digital tools but the use of digital tools, their support, and adoption in teaching and learning activities. Connection, teachable students, are constructed through emotionally attuned teaching, predictability of behavioral demands, and digital literate teachers. The idea of bridging the digital divide between government and the privately owned schools upon investment in infrastructure, development of a knowledge base, and development of inclusive policies is not a choice or a possibility, but a necessity in achieving progressive and equitable learning systems. This study offers not only theoretical legitimization but also practical guidance to the future of the hybrid education in the region.

6.1 Recommendations for enhanced hybrid learning

To increase the efficiency of the hybrid learning, the multi-dimensional approach is necessary through first improving the digital infrastructure of the stigmata, making sure that they have high speed internet connection through which the teachers and the students can access. They should be fitted with interactive equipment, high end software licenses that would enable smooth teaching and learning process and training of teachers as well. Frequent training sessions aimed at on-platform navigation, multimedia production, engagement methods in the students can considerably increase levels of confidence and competence in the teacher. Also, practical problem solving classes must be held in order to make teachers ready to solve digital issues.

Learning should be interactive and inclusive and dynamic e.g. by adding polls, quizzes, and breaking rooms to lessons to create more interaction but also alleviate screen fatigue. In order to establish collaborative learning environment peer interactions strategies must be focused on. To achieve effective evaluation assessment the practices should adapt to hybrid model, project based and open book assessments are to be promoted and digital portfolio and automated feedback tools are to be deployed.

Another important step towards improvement is to find effective technical support systems. Help desks are to be established in the institutions with a view of offering a live solution to technical challenges, accompanied with tutorial guides and FAQs on online platforms. Lastly, the hybrid learning approaches require student centric flexibility to be promoted. Flexible deadlines, recordings of sessions and individual feedback enables the students to learn at their pace thus improving their learning experience and overall satisfaction.

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