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Editorial Notes

We take great pleasure in announcing the release of Jahangirnagar University Journal of Business Research (JUJBR), Volume 25, Number 01, scheduled for June, 2025. Going forward, we are publishing two journals annually, with releases in June and December. The successful culmination of JUJBR involved a distinguished Advisory Board, a robust Reviewer Board, and a supportive Editorial Board from renowned national and international business schools along with IBA-JU.

JUJBR is dedicated to showcasing high-quality, authentic, and invaluable research focused on contemporary aspects of business, commerce, and the economy. For this issue, out of a substantial pool of scholarly articles, only eight have been chosen, each addressing different facets of business.

In the very first paper, the researchers investigated the role of mobile financial services on financial inclusions and economic growth of Bangladesh. Eleven independent variables represented financial inclusion and foreign direct investment has been used as proxy measures of economic growth. Results showed that financial inclusion is crucial to Bangladesh's economic growth. The second paper investigated the transformative potential of Artificial Intelligence technologies. The results demonstrate statistically significant correlations among five AI technologies including Expert Systems, Decision Support Systems, Image Recognition and Vision, Deep Learning, and Neural Networks in Bangladesh's ready-made garment industry.

The third paper explored the key contributing factors of the price earnings ratio (P/E) in Bangladesh's capital market, focusing on firm-specific, non-financial, and macroeconomic variables. The fourth paper explored how organizations are transforming their Learning and Development (L&D) practices to strategically prepare for the future of work. The findings showed a move towards aligning L&D with wider business goals, a focus on digital skills, leadership development, and self-directed learning via e-learning platforms.

The fifth paper explored the skill development gaps among Bangladeshi graduates from the perspective of Human Resource Development in higher education. The findings revealed critical deficiencies in soft skills, communication, competence, professional etiquette, problem-solving, critical thinking, and real-world job readiness. Limited collaboration between academia and industry, along with outdated curricula, was identified as a

major contributor to these gaps. The study recommends curriculum reform, structured soft skills training, enhanced faculty-industry engagement, and experiential learning approaches to better align higher education outcomes with the demands of a modern workforce.

In the sixth paper, the research aims to understand the factors influencing the adoption of FinTech in Bangladesh's state-owned commercial banks. The findings suggested that the banks should increase public knowledge and understanding of financial services, implement comprehensive user financial literacy programs, and collaborate with regulatory bodies to establish a regulatory framework in Bangladesh's state-owned commercial banks. In the seventh paper, the research aims to understand how financial and nonfinancial factors affect job satisfaction and stress levels, as well as how job stress influences job happiness of the primary school teachers of Bangladesh. The study found that the financial factors and the non-financial factors have significant impacts on job satisfaction and job stress. Job stress also has significant impacts on job satisfaction. Improving the standard of education and the general well-being of the teaching staff may be greatly impacted by the job stress and happiness of primary school teachers in Bangladesh

The eight and the final paper investigated the impact of green training on employee retention, focusing on the mediating role of green work engagement. The results emphasized the necessity of investing in comprehensive green training programs that encompass not only technical skills but also motivational elements. Integrating green training into the overall HRM strategy can improve the company's reputation, as well as can attract environmentally conscious workers.

We have successfully been able to publish this journal with the grace of the Almighty. We extend our gratitude to all who supported us physically and intellectually, acknowledging the invaluable suggestions of reviewers that enhanced all the articles. Special thanks to the Advisory Board members who have provided their insightful suggestions for the enrichment of this Journal. In addition, I would like to express my thanks to Mr. Matiur Rahman Khan, and Mr. Delwar Hossain of IBA-JU for their administrative support.

Finally, we express heartfelt thanks to all esteemed members of the Editorial Board for their unwavering support throughout this journey.

Ireen Akhter, PhD
Professor, IBA-JU

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CONTENTS

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The Role of Mobile Financial Services (MFSs) on Financial Inclusions and Economic Growth of Bangladesh

JUJBR

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Abstract: *Brining the nonbanking people into the banking platform is termed as financial inclusion which could be a key driver to accelerate the economic growth of an economy. This study aims to establish whether MFS contribute in financial inclusion which further contribute in the economic growth of Bangladesh. After establishing significant contributions of MFSs to financial inclusion using t-tests' results, the short and long run contribution of financial inclusion on economic growth of Bangladesh has been assessed. Secondary monthly data ranging from December 2019 to January 2024 (50 observations) has been utilized using ARDL model. Foreign direct investment (FDI) has been used as proxy measures of economic growth. Eleven (11) independent variables representing financial inclusion include number of total registered clients (NORC), number of total transactions (NOTT), total transactions (TT), inward remittance (INREM), cash in transactions (CIT), cash out transactions (COT), personal to personal (P2P), business to personal (B2P), personal to business (P2B), merchant payment (MP), and government payment (GP). Results from ARDL short-run association, and long-run association state that financial inclusion is crucial to Bangladesh's economic growth.*

Keywords: *Financial Inclusion, Mobile Financial Services (MFS), Mobile Banking*

1. Introduction

1.1 Background of the study

Mobile Financial Services (MFS) have become a revolutionary financial development in the world, providing people with a convenient digital access to transactions, saving, remittances, and payments. MFS platforms in most developing nations in Africa and South Asia have minimized access barriers to financial services by cutting down documentation, costs, and accessing remote populations (GSMA, 2023; Andrianaivo and Kpodar, 2011). In Bangladesh,

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where conventional banking infrastructures are still low in rural regions, MFS has developed swiftly with bKash, Nagad, and Rocket providers as one of the primary sources of financial inclusion.

According to the different studies, financial inclusion (FI) depends on such factors as account ownership, the diversity of transactions, remittance channels, merchant payments, and mobile-based transfers (Kim et al., 2018; Aitaa et al., 2023). According to the financial intermediation theory, efficiently structured financial systems encourage savings, investment, and allocation of resources thus contributing to the growth of the economy (Levine, 2005). Digital financial services go further, allowing low-income households and small businesses to conduct transactions in a safe way, lessen cash dependency, and enhancing their involvement in economic activities (Chatterjee, 2020). By adopting mobile at scale, Bangladesh provides an interesting setting to explore how MFS-based inclusion can be converted into overall economic effects, especially via foreign direct investment (FDI), which is indicative of investor confidence and economic dynamism.

Although more and more literature is available on the topics of financial inclusion and digital finance, there are still a number of gaps. The existing literature on Bangladesh has largely evaluated the FI based on cross-section surveys or demographics or general measures of access, but has not investigated how the particular elements of MFS lead to inclusion and economic growth. More so, the number of studies that employ high-frequency monthly data to determine the dynamic short-run and long-run impacts of MFS on economic performance is very low.

That is why the main contributions of the study are threefold. First, it offers an in-depth evaluation of financial inclusion through the analysis of an extensive variety of MFS variables that include both access and utilization aspects. Second, it introduces a two-step connection MFS expansion → financial inclusion → economic growth and thus contributes to the theoretical and empirical knowledge on the digital finance in emerging economies. Third, it uses strict time-series methods to identify both short-run and long-run impacts, which would provide insights to policy-makers who aim to implement digital financial strategies in national economic objectives.

As financial services in Bangladesh are becoming digitalized very rapidly, it is high time to know how MFS affects financial inclusion and economic growth. This paper thus discusses the contribution of MFS towards increasing financial inclusion and explores how inclusion promotes Economic development of Bangladesh especially through inflow of foreign investment.

1.2 Objective of the study

The basic goal of this study includes the role of mobile financial services (MFSs) on the growth and expansion of financial inclusion in Bangladesh, and how financial inclusion is contributing to the economic growth of Bangladesh. More specific objectives of this study are given below:

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i. To identify and examine the factors related to mobile financial services (MFSs) that influences the financial inclusions in Bangladesh.
ii. To assess whether MFSs contributes to the economic growth of Bangladesh in the short-run.
iii. To identify whether MFSs influences the economic growth of Bangladesh in the long-run.

2. Literature Review

Financial inclusion is often used in the literature as described in terms of the availability, penetration and utilization of financial services, whereas economic growth is usually indicated in terms of improvement in GDP, per capita income, development of the financial sector, and the total economic activity.

Some studies in Africa have found that there is a positive association between financial inclusion and economic development. Aitaa and Amadi (2023) demonstrate that the relationship between availability, penetration, and usage on one hand and growth on the other is positive, and that financial inclusion can contribute to the economic development. In a similar vein, Oyadeyi (2024) points at the relevance of financial innovation through the application of MIDAS (Mixed-Dimensional Autoregressive Distributed Lag) and ARDL (Autoregressive Distributed Lag) methods and concludes that cheque, banking innovation like point of sales (POS) and internet transaction do not contribute to the economic growth of Nigeria significantly. These conclusions show that the use of contemporary digital tools, such as MFS-related services, facilitates financial inclusion and economic activity.

A review of five years of agent banking developments in Bangladesh by Chakrobortty and Sultana (2023) indicates that the groups with limited access to formal financial services such as rural, poor and unbanked people have gained more access to formal financial services. Based on Bangladesh Bank data, they report a gradual increase in the indicators of agent banking, the role of innovative delivery systems to bridge the access divide. Akhter and Khalily (2020) also indicate that MFSs in Bangladesh have grown at an alarming rate since 2011 and have resulted in a higher level of inclusivity and efficiency in the services they offer. Their research indicates that demographic variables, including poverty, city dwellers, gender, professions, education, migration, and others, have a bearing on mobile financial services usage and that specific policies should be designed to address the most underserved users.

Based on data on 22 SSA countries, Ifediora et al. (2022) demonstrate the positive impact of mobile financial inclusion, in particular, availability and penetration on growth, yet they also mention that mobile money agents may also act as obstacles to such outcomes, which is why such a financial education should be paid special attention. Here, Ndiaye et. al., (2022) utilize the Granger and dynamic panel causality tests on 20 SSA countries and establish that financial inclusion has a positive influence on economic growth where

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unidirectional causality is observed to flow in the direction of inclusion to the growth, which prompts them to propose the expansion of inclusion policies.

When applied to 24 developing countries, Wasim et al. (2022) discover that trade and financial inclusion have a substantial and positive influence on the economic growth. According to their findings, financial inclusion enhances the gains of trade, and such strategies as multilateral agreements and market diversification are supported. A study by Ahassan et al. (2021) on the subject of mobile money in SSA between 2011 and 2018 reveals that the growth in the number of mobile money agents and mobile money volume is positively associated with GDP per capita and growth in the financial sector. Their results point to the fact that mobile money helps to give the unbanked populations an extra financial channel, which assists household expenditures, remittances, and business.

In the Middle East and North Africa (MENA), Emara and El Said (2021) establish a positive relationship between financial inclusion indicators, including bank account ownership, the presence of ATMs, and access to business loans and GDP per capita in the Middle East and North Africa (MENA) during the period between 1990 and 2018. Their results highlight the essence of good governance, such as political stability and judicial independence, to enhance the full advantage of inclusion and increase access to finance.

The other research also points out the association of FI and economic performance. In their study, Thaddeus et al. (2020) provide 22 SSA countries with results based on a vector error correction and Granger causality tests that prove that economic growth causally influences digital inclusion, and consumer education. Chinoda and Kwenda (2019) discuss the relationship between FI, competition, bank stability, mobile phone usage and development in Africa and conclude that these variables have a positive and significant impact on inclusion, and economic efficiency. Kim et al. (2018) concentrate on OIC countries, which proves a two-way causal relationship between FI and economic growth.

Lenka and Sharma (2017) conclude that in India, financial inclusion has been strengthened by financial liberalization between 1980 and 2014, and inclusion has a positive relationship with growth based on indices and models derived through PCA such as ECM and ARDL. Investigating the situation in Nigeria between 1986 and 2015, Okoye et al. (2017) have discovered that rural credit alleviates poverty, whereas credit to the private sector has no significant effects on economic growth and should suggest reforms in monetary policy to enhance financial resources distribution. In a study based on GMM analysis of 44 countries, Lundqvist et al. (2014) indicate that mobile phones usage has a positive impact on financial inclusion and growth by increasing bank savings and loans per capita.

The technological advancement is also mentioned as the factor in the past. Andrianaivo and Kpodar (2011) discover that the growth in Africa is being propelled by ICT development, especially mobile phones and that financial inclusion enhances this growth. Based on Honohan (2008) financial inclusion

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indicator, Rojas-Suarez (2010) indicates national level obstacles as social underdevelopment, economic instability, ineffective legal systems, income inequality, and regulatory restraint, showing national-level obstacles determine access.

On the whole, the studies examined that mobile financial services and other online platforms are always helpful in increasing FI through access, barriers, and efficiency. The increased FI in its turn promotes economic growth by providing better participation in financial activities, improved savings and credit flows, and improved economic participation among the previously marginalized groups. These facts underscore the importance of investigation about the role of MFSs in improving FI and supporting economic growth in Bangladesh.

3. Conceptual Framework

3.1 Conceptual Linkage of Mobile Financial Services (MFS) on the Financial Inclusion

To develop the conceptual linkage of mobile financial services (mfs) on the FI, an analysis has been done in the first phase to identify the contribution of MFS on the FI in Bangladesh. A variety of selected variables were incorporated into the study, including MFS Agent, MFS Male Account, MFS Female Account, MFS Other Account & MFS Total Account. This analysis uses monthly data for all the variables from December-2018 to March-2024 (64 observations per variable) obtained from the Bangladesh Bank. Then for assessing growth of all the listed MFS growth indicators, this study split the entire sample period into three terms (i.e. December 2018 to September 2020 (1st Term); October 2020 to July 2022 (2nd Term); and August 2022 to March 2024 (3rd Term)). For a variety of data collection need, the official websites Bangladesh Bank (BB) have been utilized frequently.

3.2 Variables Specification

MFS Agent - An MFS agent in Bangladesh is authorized to perform transactions like transfers, payments (business, government, merchant), and handle microfinance or insurance-related services.

MFS Male Account - In Bangladesh, 82.58% of males use MFS accounts, often for advanced services like bill payments and business, while women primarily use them for sending and receiving money (*Star Business Report, Mar 9, 2024*).

MFS Female Account - In Bangladesh, only 47.16% of women have MFS accounts, highlighting a concerning gender gap in usage compared to men (Star Business Report, Mar 9, 2024).

MFS Other Account - These accounts—held by minors, students, and third-gender individuals—boost FI and contribute to Bangladesh's economy by involving diverse, often underserved population groups in financial activities.

MFS Total Account - It is a combination of all accounts: MFS Agent, MFS Male Account, MFS Female Account and MFS Other Account.

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3.3 Model Specification

t-test - A t-test examines hypotheses and determines whether a difference between two group means is, or is not, statistically significant. It is based on the use of t-distribution, distribution with the similar probability to distribution normal, which is widely used on numerical data. The p – value tells of probability that the differences observed occurred by chance. If samples distributions are normal, the difference of them will be also normal.

The unit root test is expressed as follows:

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

Here,

$$\bar{x}_1 = observed\ mean\ of\ 1^{st}\ sample$$
$$\bar{x}_2 = observed\ mean\ of\ 2^{nd}\ sample$$
$$\bar{s}_1 = standard\ deviaiton\ of\ 1^{st}\ sample$$
$$\bar{s}_1 = standard\ deviaiton\ of\ 2^{nd}\ sample$$
$$n_1 = sample\ size\ of\ 1^{st}\ sample$$
$$n_2 = sample\ size\ of\ 2^{nd}\ sample$$

3.4 Conceptual Linkage of Financial Inclusion on the Economic Growth of Bangladesh

The second phase different FI related variables have been used to measure their short and long run influence on the three dependent variables measuring economic growth. The conceptual framework is depicted below:

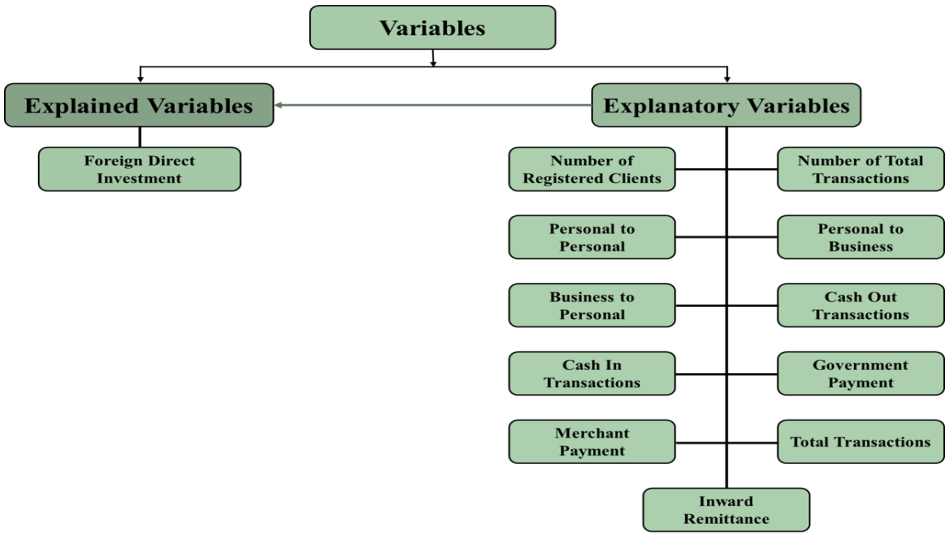

Figure 1: Dependent Variables, and Independent Variables

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3.5 Variable Specifications

Dependent Variables

Foreign Direct Investment (FDI)

Proxy: Growth of Foreign Direct Investment

Direct investments in companies or projects made by foreign investment in local markets is referred to as FDI. FDI has been critical in correcting aspects of resource deficiencies, which were already marked among the significant concerns from 1971 and had such policy measures such as the 1999 industrial policy to promote its increase (Rahman, 2015).

Independent Variables

Number of Registered Clients (NORC)- NORC in MFS refers to the total number of individuals registered to access mobile financial services including cash-in, cash-out, peer-to-peer transfers and bill payment.

Number of Total Transactions (NOTT) - NOTT in MFS is an indicator of the total number of transactions within MFS, which monitor all transactions made through mobile channels e.g. P2P transfers, cash-in, and cash-out, as well as bill payments.

Personal to Personal (P2P) - With MFS, users can also carry out P2P transactions; securely sending money to another individual's mobile wallet eliminating the need to use cash or cheques.

Personal to Business (P2B) - In MFS, P2B allows users to send secure, cashless payments of money to businesses from their mobile devices, giving them a quick and simple way to pay.

Business to Personal (B2P) - B2P transactions in mobile financial services (MFS) enable businesses to directly send funds to individuals for such reasons as salary disbursement, vendor payments and refunds.

Merchant Payment (MP) - Mobile Financial Services' (MFS) Merchant Payments (MP) allows individuals and businesses to transmit mobile money to merchants to facilitate safe, convenient and cashless transactions for purchases and services.

Total Transactions (TT) - The total transaction volume under MFS aggregates the total value of all cash-in, cash-out, peer to peer, bill payments and merchant payments made through the system.

Cash In Transactions (CIT) - In the MFS, this is a "cash-in transaction" when customer deposits cash through the designated agents/rail stores which are then transacted and turned into virtual funds within your mobile wallet.

Cash Out Transactions (COT) - The means of having funds withdrawn from MFS mobile wallet to cash in MFS are through authorized agents, stores and ATMs that can do mobile money transactions.

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Inward Remittance (INREM) **-** Inward remittance under MFS system refers to making foreign money going into a mobile wallet sided for helping relatives abroad; executing international trade or cross-border financial activities.

$$\boldsymbol{FDI} = \boldsymbol{\alpha} + \boldsymbol{\beta_1}\mathrm{NORC} + \boldsymbol{\beta_2}\mathrm{NOTT} + \boldsymbol{\beta_3}\mathrm{TT} + \boldsymbol{\beta_4}\mathrm{MP} + \boldsymbol{\beta_5}\mathrm{GP} + \boldsymbol{\beta_6}\mathrm{P2P} + \boldsymbol{\beta_7}\mathrm{P2B} + \boldsymbol{\beta_8}\mathrm{CIT} + \boldsymbol{\beta_9}\mathrm{COT} + \boldsymbol{\beta_{10}}\mathrm{B2P} + \boldsymbol{\beta_{11}}\mathrm{INREM} + \varepsilon$$

4. Methodology

4.1 Research Methods

This research discusses the impact of Mobile Financial Services (MFSs) on achieving financial inclusion and the economy of Bangladesh accordingly. The first part looks at several indicators for MFSs – number of agents, male, female and total accounts – through mean growth and standard deviation, to examine their part in promoting financial inclusion. The second part assesses the effects of financial inclusion on economic growth where Foreign Direct Investment (FDI) is used instead. Eleven MFS-specific variables are analyzed: number of registered clients (NORC), number of transactions (NOTT), total transactions (TT), inward remittance (INREM), cash in/out transactions (CIT, COT), P2P, B2P, P2B, merchant payments (MP), and government payments (GP). Before considering the Augmented Dickey-Fuller (ADF) test for order of integration, descriptive statistics and Pearson's correlation matrix are presented. Further tests of the variables incorporated at I(0) or I(1) are made using Autoregressive Distributed Lag (ARDL) model for short run relations. Long-run relationships are analyzed through the Bound Cointegration test (Pesaran et al., 2001), followed by Error Correction Model (ECM) to generate the estimates for the short-run dynamics.

The selection process of approaches for the time-series analysis is mainly based on the outcomes of the unit root test that specify the stationarity of the variables (Shrestha & Bhatta, 2018). The variables selected are tested for stationarity in this research using the Augmented Dickey Fuller (ADF) unit root test.

4.2 ARDL Model Specification

The ARDL model, using ordinary least squares (OLS), handles time series data with various integration orders, efficiently. The model depends on correct lag selection and uses a general-to-specific method of modeling (Shrestha & Bhatta, 2018). ARDL model can well deal with serial correlation when appropriate lags are used (Ghatak & Siddiki, 2001). Using ARDL, cointegration is calculated over both short and long periods, and unbiased estimates are offered (Pesaran et al., 2001). This model is usually noted as ARDL $(p, q_1, \ldots\ldots, q_k)$, where p denotes the dependent variable's number of lags, and q_k denotes k^{th} regressors.

The following is an expression of the ARDL model-

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$$y_t = \alpha + \sum_{i=1}^{p} y_i y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} X_{j,t-1}\beta_{i,j} + \in_t$$

Regressor which contain lags are made dynamic while those which do not contain lags as fixed. Selection of appropriate lags for each variable (i.e., specifying $p, q_1, \ldots\ldots, q_k$) in the ARDL model is done with the assistance of criteria for model selection such as Hannan-Quinn, Akaike and Schwarz (Ali, 2020).

4.3 Bounds Cointegration Test

There may or may not be a causal link between the dependent and independent variables in the ARDL model over the long term, and Pesaran et al. (2001) have described a way, bounds test, for checking so. The Bounds test procedure can be expressed using the following equation-

-

$$\Delta y_t = -\sum_{i=1}^{p-1} y_i^* \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j-1}} \Delta X_{j,t-1}\beta_{i,j,i^*} - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}\delta_j + \in_t$$

Thus, the following simple test can be used to determine if long-run relationships exist.

$$\rho = 0$$

$$\delta_1 = \delta_2 = \cdots = \delta_k = 0$$

Bounds, such as critical values, have been provided by Pesaran et al. (2001) for the most common cases in which the explanatory variables are a mix of I(0) and I(1). They have also provided bounds for the cases in which all of the regressors are I(0) or I(1).

4.4 Data and Data Sources

The secondary data sourced in this research was from relevant sources. The financial inclusion indicator was measured using Bangladeshi Mobile Financial Services (MFS) data from Bangladesh Bank. In order to analyze the relationship between financial inclusion and economic growth, in which case, FDI was used as dependent variable, data was also extracted from Bangladesh Bank. The explanative variables retained are NORC, NOTT, P2P, P2B, B2P, CIT, COT, GP, MP, TT and INREM. The analysis of financial inclusion was performed using monthly observations from December 2018 to March 2024 (64 observations), while economic growth was analyzed with data from December 2019 to January 2024 (50 observations).

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5. Analysis & Findings

5.1 Financial Inclusion through Mobile Financial Services (MFSs)

This paper examines the development story of Mobile Financial Services (MFS) and evaluates their role in limited inclusion and economic development in Bangladesh. Mobile Financial Services has its growth assessed through such factors as agents, gaps between male and female accounts, types of accounts and overall accounts count. The data is grouped into three periods: ① December 2018–September 2020; ② October 2020–July 2022; and ③ August 2022–March 2024. Through the analysis of the average growths of these indicators and the use of a t-test, we verify MFS growth.

The growth of MFS agent has been presented in table 1. It is observed that the mean MFS agent is increasing and the mean growth rate is found positive. The standard deviation of MFS agent is also found increasing in three sequential terms. The gradual growth of MFS agent in different specified term is also observed in figure 2.

Table 1: Growth of MFS Agent

Periods	No. of Obs.	Urban MFS Agent			Rural MFS Agent			Total MFS Agent		
		Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000
1st term	17	556.37	0.95%	42.12	522.23	1.32%	35.16	1,078.60	1.11%	75.46
2nd term	22	720.69	1.03%	50.81	666.72	1.29%	49.05	1,387.41	1.15%	96.25
3rd term	20	811.99	0.90%	59.65	808.65	0.60%	26.52	1,620.64	0.75%	85.52

Note: Authors' own calculation

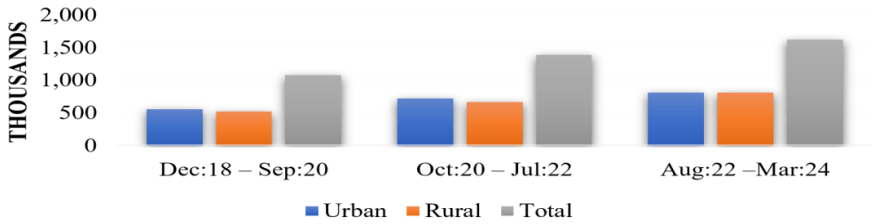

Figure 2: Growth of MFS Agent

Table 2 includes the t-test results and p-values, under the assumption that there is no mean variation in the MFS agents' numbers as time frames. In pairwise comparisons, we find that the null hypothesis of zero mean difference is rejected at the 5% level between the 1st and 2nd terms for urban, rural, and total MFS agents. Similar findings can be gone for when the 2nd and 3rd terms are being compared for each segment. In combination, these findings show a dramatic increase in the average number of agents for both urban, rural and total MFS across terms, with growth present in each segment.

The growth of MFS male account has been presented in table 3. The mean values MFS male account is increasing in urban, rural and total segments. The standard

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deviation in the 3rd term in all the three segments is also found to decrease as compared to the 1st and 2nd terms. The gradual growth rate of MFS male account is found highest in the 2nd term but 1st and 2nd term growth rate are also positive which is presented in figure 3.

Table 2: t-test for MFS Agent

H_0: Mean difference is zero.									
Periods	**Urban MFS Agent**			**Rural MFS Agent**			**Total MFS Agent**		
	d.f.	***t*- stat**	***p*- value**	**d.f.**	***t*- stat**	***p*- value**	**d.f.**	***t*- stat**	***p*- value**
Between 1st Term and 2nd Term	40	-11.99	4.04E-15	37	-11.39	5.83E-14	39	-12.14	4.06E-15
Between 2nd Term and 3rd Term	35	-5.39	2.45E-06	31	-12.1	1.42E-13	38	-8.52	1.21E-10

Note: Authors' own calculation

Table 3: Growth of MFS Male Account

Periods	**No. of Obs.**	**Urban MFS Male Account**			**Rural MFS Male Account**			**Total MFS Male Account**		
		Mean '000	**Mean Growth**	**δ '000**	**Mean '000**	**Mean Growth**	**δ '000**	**Mean '000**	**Mean Growth**	**δ '000**
1st term	17	20,000.40	-	727.53	25,193.07	-	1,187.24	45,193.47	-	1,907.29
2nd term	22	38,992.90	0.95%	1,592.23	49,354.10	0.96%	1,403.69	88,347.01	0.95%	2,972.54
3rd term	20	53,236.89	0.37%	675.57	65,973.68	0.34%	1,086.73	119,210.56	0.35%	1,750.33

Note: Authors' own calculation

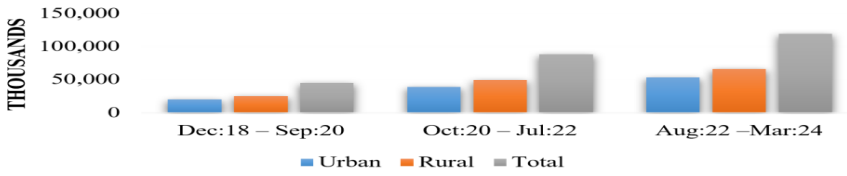

Figure 3: Growth of MFS Male Account

The findings (Table 4) of pairwise comparisons mean that null hypothesis of zero mean difference is rejected at 5% level for urban male accounts between 1st and 2nd terms, which shows significant difference. Analyses of the rural and total segments give similar results. The null hypothesis is retained for all segments if judged by 2nd and 3rd terms. Generally, it is clear that MFS male accounts have increased positively over terms in both urban, rural and total areas.

Table 4: t-test for MFS Male Account

H_0: Mean difference is zero.									
Periods	**Urban MFS Male Account**			**Rural MFS Male Account**			**Total MFS Male Account**		
	d.f.	***t*- stat**	***p*- value**	**d.f.**	***t*- stat**	***p*- value**	**d.f.**	***t*- stat**	***p*- value**
Between 1st Term and 2nd Term	28	-10.85	7.72E-12	40	-13.14	2.11E-16	34	-12.22	2.73E-14
Between 2nd Term and 3rd Term	27	-8.24	3.83E-09	37	-9.36	1.34E-11	32	-8.95	1.60E-10

Note: Authors' own calculation

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The growth of MFS female account has been presented in table 5. The period wise MFS female account shows that the average MFS female account is rising in all the three terms, and the average growth rate is positive. The standard deviation of MFS female account is lowest in the 3rd terms as compared to the 1st and 2nd term. The gradual growth of MFS female account in different specified term is also presented in figure 4.

Table 5: Growth of MFS Female Account

Periods	No. of Obs.	Urban MFS Female Account			Rural MFS Female Account			Total MFS Female Account		
		Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000
1st term	17	12,593.54	-	618.04	28,935.38	-	1,040.20	41,528.91	-	1,654.82
2nd term	22	26,061.43	1.07%	1,021.70	41,620.01	0.44%	445.30	67,681.44	0.63%	1,344.74
3rd term	20	49,155.59	0.89%	509.61	49,444.19	0.19%	718.13	86,244.20	0.27%	1,224.00

Note: Authors' own calculation

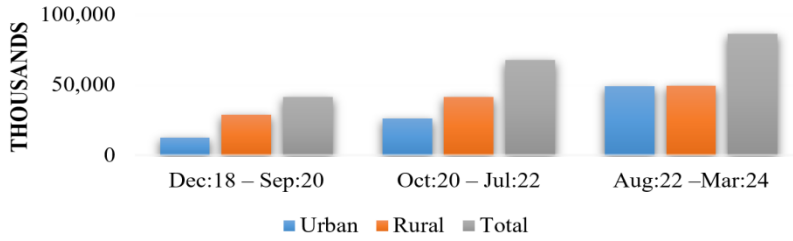

Figure 4: Growth of MFS Female Account

In Table 6, the t-test statistics with its respective p-values are presented to decide if there is a mean difference in MFS female accounts for two periods. For urban accounts by females pairwise comparisons reject the null hypothesis assuming zero difference in mean at the 5% level between the 1st and 2nd terms indicating a difference. For rural segment and also for total segment, null hypothesis of no difference between first and second term is not rejected. Similar results are attained when 2nd and 3rd terms are paired for all segments. The general findings indicate rising MFS female account activity over each term for all segments.

Table 6: t-test for MFS Female Account

H_0: Mean difference is zero.									
Periods	Urban MFS Female Account			Rural MFS Female Account			Total MFS Female Account		
	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value
Between 1st Term and 2nd Term	33	-11.28	3.66E-13	28	-11.2104	3.65E-12	40	-12.26	1.96E-15
Between 2nd Term and 3rd Term	35	-18.49	6.05E-20	29	-9.45	1.16E-10	38	-10.21	9.59E-13

Note: Authors' own calculation

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The growth of MFS other account has been presented in table 7. It is observed that the mean MFS other account is increasing and the mean growth rate is found positive. It is surprising to found the mean MFS other account growth rate is highest is the 2nd term in our analysis. The standard deviation of MFS other account is higher in the 1st and 3rd term but found lowest in the 2nd tern in all the urban, rural, and total segment. The gradual growth of MFS other account in different specified term is also observed in figure 5.

Table 7: Growth of MFS Other Account

Periods	No. of Obs.	Urban MFS Other Account			Rural MFS Other Account			Total MFS Other Account		
		Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000
1st term	17	60.96	-	13.08	36.29	-	7.48	95.67	-	21.05
2nd term	22	200.50	2.29%	6.45	120.20	2.31%	3.85	320.70	2.35%	10.28
3rd term	20	333.34	0.66%	12.93	169.51	0.41%	7.42	502.85	0.57%	19.39

Note: Authors' own calculation

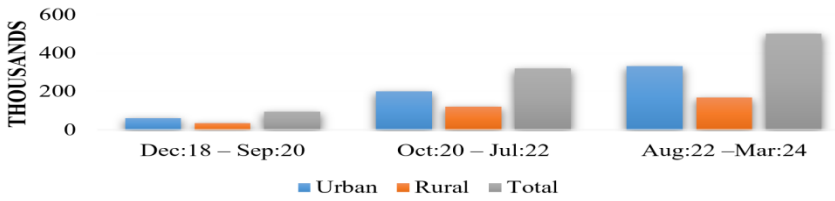

Figure 5: Growth of MFS Other Account

We provide the t-Test statistics and p-values that we calculated under the null hypothesis that the mean difference in MFS other accounts is 0 for the two terms in Table 8. The pair-wise comparison leads to rejection of the null hypothesis of the zero-mean difference at the 5% level for urban MFS other accounts between 1st and 2nd terms which can be are said to be significant. The same results are also observed for the 2nd and 3rd terms in the urban, rural, and total segments. The null hypothesis is rejected for each of the three segments showing a positive trend in MFS other accounts through terms, all segments having positive mean differences.

Table 8: t-test for MFS Other Account

H_0: Mean difference is zero.									
Periods	Urban MFS Other Account			Rural MFS Other Account			Total MFS Other Account		
	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value
Between 1st Term and 2nd Term	31	-9.57	4.57E-11	29	-9.78	5.49E-11	31	-9.79	2.65E-11
Between 2nd Term and 3rd Term	27	-9.20	4.15E-10	27	-5.90	1.38E-06	28	-8.30	2.47E-09

Note: Authors' own calculation

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The growth of MFS total account has been presented in table 9. It is observed that the mean MFS total account is increasing and the mean growth rate is found positive except 3rd term of rural MFS total account. The standard deviation of MFS total account isn't found increasing in three sequential terms, sometimes it increases and sometimes it decreases. The gradual growth of MFS total account in different specified term is also observed in figure 6.

Table 9: Growth of MFS Total Account

Periods	No. of Obs.	Urban MFS Total Account			Rural MFS Total Account			Total MFS Total Account		
		Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000	Mean '000	Mean Growth	δ '000
1st term	17	32,666.15	-	1,345.70	54,641.15	-	2,222.39	86,818.05	-	3,572.38
2nd term	22	65,254.84	1.00%	2,613.54	91,094.31	0.67%	1,743.27	156,349.14	0.80%	4,296.95
3rd term	20	90,658.83	0.39%	1,192.11	11,529.87	-0.87%	1,802.54	205,957.61	0.32%	2,980.33

Note: Authors' own calculation

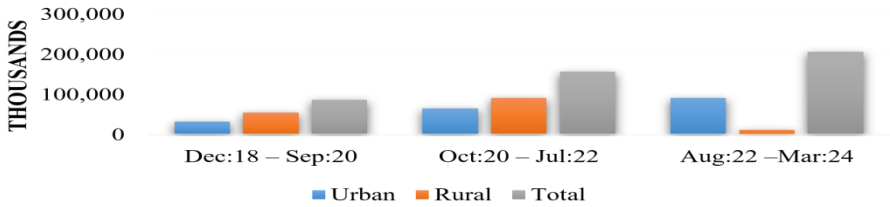

Figure 6: Growth of MFS Total Account

Table 10 presents t-test statistics and p-values with assumption of no mean difference between two periods on MFS total accounts. By analysis through pair-wise comparisons, null hypothesis of zero mean difference for urban MFS total accounts between the 1st and 2nd terms is rejected at the 5% level, indicating a significant difference. Similar results are presented for rural and total segments when comparing 1st and 2nd terms. As to the 2nd and 3rd terms, the null hypothesis of no-mean difference is rejected for all segments except rural in the 3rd term. In general, the data shows that MFS total accounts have experienced an increase in all examined segments.

Table 10: t-test for MFS Total Account

H_0: Mean difference is zero.									
Periods	Urban MFS Total Account			Rural MFS Total Account			Total MFS Total Account		
	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value	d.f.	*t*- stat	*p*- value
Between 1st Term and 2nd Term	30	-11.07	2.03E-12	37	-12.71	2.26E-15	39	-12.44	1.86E-15
Between 2nd Term and 3rd Term	28	-8.84	6.74E-10	38	-9.65	4.52E-12	35	-9.49	1.65E-11

Note: Authors' own calculation

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5.2 Role of Financial Inclusion on Economic Growth

Table 11 summarizes the major variables studied in this research using the results of their descriptive statistics. Foreign direct investment (FDI) demonstrates average monthly growth rate of 0.48% and relatively stable standard deviations thus indicating controlled fluctuations. The average registered client count (NORC) is 1,395.44 while total monthly transactions (NOTT) is 374 million, with a fairly stable pattern. P2P transfers show the highest average monthly value (BDT 21,950.43) and the highest variation. On average the B2P transfers account to BDT 2554.15 while average P2B transfer stands at BDT 1574.22. With the help of the MFS, government payments amounting to on average BDT 626.97 per month are possible, but the high standard deviation of 866.03 indicates that there is considerable variation of these transactions. MFS inward remittances have a mean value (MEA) of BDT 291.63 with limited variance. Merchant payments (MP) account significantly for BDT 3,001.97 per month. The average CIT and COT transactions are BDT 23,721.39 and BDT 21,710.08 respectively, thereby the maximum standard deviation among all types of transactions. In general, the data highlight this increased ubiquity and spread of MFS in Bangladesh, specific emphasis is placed onto P2P transfers and cash-based activities, with notable disparities in stabilities in various transaction categories.

Table 11: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Maximum	Minimum
FDI	50	0.0048	0.0348	0.093	-0.067
B2P	50	2,554.15	947.67	5,187.91	1,004.68
CIT	50	23,721.39	8,724.60	40,228.33	8,709.88
COT	50	21,710.08	7,746.63	37,707.68	8,227.60
GP	50	626.97	866.03	4,066.98	13.76
INREM	50	291.63	172.51	645.1	29.68
MP	50	3,001.97	1,614.98	6,494.55	233.7
NORC	50	1,395.44	516.74	2,204.57	795.08
NOTT (Million)	50	374	104	573	218
P2B	50	1,574.22	880.21	3,330.59	271.32
P2P	50	21,950.43	7,330.92	35,276.21	9,242.88

ADF test outcome in Table 12 is used to determine the stationarity of the variables. Stationarity could not be overemphasized because it has direct effects on model selection. In the case of time series data that have varying degrees of integration, ARDL model is preferred. For uniform integration levels of variables, Johansen's co-integration treatment is adopted. For non-stationary data, OLS must be adjusted indicating the role of unit root testing prior to time series models application (Shrestha & Bhatta, 2018).

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Table 12: ADF Unit Root Test

Variable	ADF Test's Prob.		Order of Integration
	I(0)	I(1)	
NoRC	0.8673	0.0000	I(1)
NoTT	0.8397	0.0000	I(1)
TT	0.8339	0.0000	I(1)
INREM	0.0293		I(0)
CIT	0.9351	0.0000	I(1)
COT	0.9127	0.0000	I(1)
P2P	0.3687	0.0000	I(1)
B2P	0.0276		I(0)
P2B	0.2569	0.0000	I(1)
MP	0.5093	0.0000	I(1)
GP	0.0002		I(0)
FDI	0.1038	0.0001	I(1)

Note: Authors' own calculation

As parameterized by the unit root test, INREM, B2P, and GP are all stationary at level; FDI and others are stationary only after having been differenced once– making them suitable candidates for ARDL estimation. Having determined the optimal lag order as 2 (appendix table 1), the ARDL model is used in this case, with FDI as the dependent variable. According to Table 13, at the level, INREM and P2B are correlated with significant negative impacts upon FDI whereas NORC is correlated with significant positive impact. For a lag, the COT, MP, NORC, and P2P have a negative impact on FDI, whereas the NOTT, P2B and TT have positive and significant effects. In the two-lag case, MP and P2P are positively and statistically correlated with FDI. However, CIT, B2P, and GP are not statistically significant in predicting FDI.

Table 13: ADF Unit Root Test

Dependent Variable: FDI
Dynamic regressors (2 lags, automatic): NORC NOTT TT MP GP P2P P2B CIT COT B2P INREM
Model selection method: Akaike info criterion (AIC)
Fixed regressors: C
Selected Model: ARDL(2, 1, 2, 1, 2, 0, 2, 1, 0, 2, 1, 0)

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
FDI(-1)	0.6919	0.144	4.8057	**0.0001*** **
FDI(-2)	-0.561	0.1359	-4.1273	**0.0004*** **
COT	-0.0655	0.1526	-0.4292	0.672
COT(-1)	-0.5249	0.1434	-3.6611	**0.0014*** **
COT(-2)	-0.132	0.086	-1.5352	0.139
INREM	-0.0882	0.0303	-2.9133	**0.0081*** **
MP	0.0452	0.0331	1.3677	0.1852
MP(-1)	-0.1637	0.0404	-4.0494	**0.0005*** **
MP(-2)	0.0465	0.0226	2.0624	**0.0512***
NORC	0.1337	0.0646	2.0708	**0.0503***
NORC(-1)	-0.1683	0.0678	-2.4817	**0.0212*** *
NOTT	0.1786	0.1187	1.5043	0.1467
NOTT(-1)	0.2754	0.0965	2.8551	**0.0092*** **
NOTT(-2)	0.1294	0.0891	1.4514	0.1608
P2B	-0.0866	0.0446	-1.94	**0.0653***
P2B(-1)	0.0839	0.0296	2.8373	**0.0096*** **
P2P	0.2045	0.1959	1.044	0.3078
P2P(-1)	-0.3627	0.1542	-2.3525	**0.0280*** *
P2P(-2)	0.1817	0.0877	2.071	**0.0503***
TT	-0.3774	0.5975	-0.6315	0.5342
TT(-1)	0.7595	0.2502	3.0361	**0.0061*** **
CIT	0.0908	0.231	0.3933	0.6979
B2P	0.0777	0.0461	1.6859	0.1059
B2P(-1)	0.0453	0.0305	1.4858	0.1515
GP	-0.0033	0.0044	-0.7646	0.4526
C	-8.4345	2.6419	-3.1926	**0.0042*** **

FDI = 0.6919 × FDI(-1) - 0.561 × FDI(-2) - 0.0655 × COT - 0.5249 × COT(-1) - 0.132 × COT(-2) - 0.0882 × INREM + 0.0452 × MP - 0.1637 × MP(-1) + 0.0465 × MP(-2) + 0.1337 × NORC - 0.1683 × NORC(-1) + 0.1786 × NOTT + 0.2754 × NOTT(-1) + 0.1294 × NOTT(-2) - 0.0866 × P2B + 0.0839 × P2B(-1) + 0.2045 × P2P - 0.3627 × P2P(-1) + 0.1817 × P2P(-2) - 0.3774 × TT + 0.7595 × TT(-1) + 0.0908 × CIT + 0.0777 × B2P + 0.0453 × B2P(-1) - 0.0033 × GP - 8.4345 × C

*Note: Authors' own calculation; ***, **, * represent significant levels are 1%, 5%, and 10% respectively.*

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Based on table 14, joint significance of model coefficients from ARDL model is found, as F-statistic and Chi Square p-value of 0.0000 are both under 0.05, rejecting the null hypothesis of no joint significance.

Table 13: Wald Test for ARDL Model

Null Hypothesis: C(1)=0, C(2)=0, C(3)=0, C(4)=0, C(5)=0, C(6)=0, C(7)=0, C(8)=0, C(9)=0, C(10)=0, C(11)=0, C(12)=0, C(13)=0, C(14)=0, C(15)=0, C(16)=0, C(17)=0, C(18)=0, C(19)=0, C(20)=0, C(21)=0, C(22)=0, C(23)=0, C(24)=0, C(25)=0, C(26)=0

Test Statistic	*Value*	*df*	*Probability*
F-statistic	8486.331	(26,22)	**0.0000***
Chi-square	220644.6	26	**0.0000***

*Note: Authors' own calculation; ***, **, * represent significant levels are 1%, 5%, and 10% respectively.*

A variety of checks on the model's adequacy were performed. No evidence of heteroscedasticity was indicated (p-values: According to the Breusch-Pagan-Godfrey test in appendix table 2, 0.8803, 0.7610); in addition, the result of the Breusch-Godfrey LM test (Appendix table 3) reflected no serial correlation (p-values: 0.4836, 0.1861). The Ramsey RESET test (Appendix table 4) excluded specification error (p-value > 0.01), and the Jarque-Bera test (Appendix figure 1) verified normality of the residuals (p-value: 0.6336). Stability was validated through the CUSUM and CUSUMSQ tests as depicted in the appendix figures 2 and 3 none of the results falling outside a 5% significance level. The null hypothesis was rejected (at the 1% significance level), as an ARDL bounds test confirmed in Table 15, according to an F-statistic: 5.3766 showed that there is a long-term relationship between FDI and explanatory variables. The results support this model's ability to stay consistent and valid over long durations.

Table 14: Bounds Test Estimates

Null Hypothesis: No level (long-run) relationship exists		
Test Statistic	***Value***	***K***
F-statistic	**5.3766*** **	11
Critical Value Bounds		
Significance	***I(0) Bound***	***I(1) Bound***
1%	2.41	**3.61**
5%	1.98	**3.04**
10%	1.76	**2.77**

*Note: Authors' own calculation; ***, **, * represent significant levels are 1%, 5%, and 10% respectively.*

As table 16 explains, the long-run cointegrating (Pesaran et al., 2001) relationships show that B2P and NOTT promote FDI while COT, INREM, and MP have adverse effects. No strong long-run relationship was determined between FDI and factors such as CIT, GP, NORC, P2B, P2P, and TT.

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Table 15: Long-run Cointegrating Test Estimates

Dependent Variable: FDI				
Variable	***Coefficient***	***Std. Error***	***t-Statistic***	***Prob.***
B2P	0.1415	0.0717	1.9728	**0.0612***
CIT	0.1045	0.2589	0.4037	0.6904
COT	-0.8311	0.221	-3.76	**0.0011*****
GP	-0.0039	0.0051	-0.756	0.4577
INREM	-0.1014	0.0355	-2.8587	**0.0091*****
MP	-0.0828	0.036	-2.2977	**0.0315****
NORC	-0.0398	0.0471	-0.8456	0.4069
NOTT	0.6712	0.1708	3.9304	**0.0007*****
P2B	-0.0031	0.0556	-0.0555	0.9562
P2P	0.0269	0.1707	0.1576	0.8762
TT	0.4397	0.622	0.7069	0.487
C	-9.7043	3.1328	-3.0976	**0.0053*****

EC = FDI - (0.1415 × B2P + 0.1045 × CIT -0.8311 × COT -0.0039 × GP - 0.1014 × INREM - 0.0828 × MP - 0.0398 × NORC + 0.6712 × NOTT -0.0031 × P2B + 0.0269 × P2P + 0.4397 × TT - 9.7043)

*Note: Authors' own calculation; ***, **, * represent significant levels are 1%, 5%, and 10% respectively.*

FDI's Error Correction Model (ECM) with the regressors is shown in table 17. The error correction coefficient, CointEq(-1), is -0.8692, and the p-value is 0.0000. This error correction coefficient means that each month, the prior dynamic disequilibrium, if any, is rectified by 86.92 percent to converge towards equilibrium.

Table 16: ECM Regression

Variable	***Coefficient***	***Standard Error***	***t-Statistic***	***Prob.***
D(FDI(-1))	0.561	0.0871	6.4426	0.0000
D(B2P)	0.0777	0.0129	6.0408	0.0000
D(COT)	-0.0655	0.0739	-0.8856	0.3854
D(COT(-1))	0.132	0.0381	3.4653	0.0022
D(MP)	0.0452	0.0187	2.4197	0.0242
D(MP(-1))	-0.0465	0.0139	-3.3462	0.0029
D(NORC)	0.1337	0.0374	3.5755	0.0017
D(NOTT)	0.1786	0.063	2.834	0.0097
D(NOTT(-1))	-0.1294	0.0528	-2.4495	0.0227
D(P2B)	-0.0866	0.02	-4.3212	0.0003
D(P2P)	0.2045	0.0722	2.8311	0.0097
D(P2P(-1))	-0.1817	0.0474	-3.831	0.0009
D(TT)	-0.3774	0.1348	-2.7992	0.0105
CointEq(-1)*	**-0.8692**	**0.0836**	**-10.3933**	**0.0000*****

*Note: Authors' own calculation; ***, **, * represent significant levels are 1%, 5%, and 10% respectively.*

6. Discussion and Conclusion

6.1 Discussion

The research explores the contributions and benefits of mobile financial services (MFS) for improving financial access in Bangladesh and evaluates how this helps

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economy grow. The investigation uses secondary data for the period December 2018–March 2024 (64 months) to conduct two important investigations. First, the research assesses the impact of MFS on financial inclusion across three distinct time intervals. The mean growth rates of MFS indicators for Bangladesh, analyzed using paired sample t-tests, demonstrate that MFS significantly contributes to the financial inclusion of the country. Second, the impact of MFS related financial inclusion variables on the growth of the economy was taken into consideration by applying ARDL model. The analysis shows that inward remittance (INREM), the number of registered clients (NORC), and P2B transactions have significant influence on FDI in the short run. Over the short horizon, the influence of such MFS variables as cash-out (COT) and merchant payments (MP) is statistically significant with regards to FDI, but business to personal (B2P) and government payments (GP) do not exhibit any such significance.

Table 17: Summary: Short-run ARDL Test Estimates

Dependent Variable: FDI											
Data Level	Independent Variable										
	B2P	CIT	COT	GP	INREM	MP	NORC	NOTT	P2B	P2P	TT
0					***		*		*		
(-1)			***			***	**	***	***	**	***
(-2)						*				*	

*Note: ***, **, * represent significant levels are 1%, 5%, and 10% respectively; (0), (-1), (-2) represent level data, one-period lag data, two-period lag data respectively.*

However, in the long-run, only B2P, COT, INREM, MP, and NOTT hits the proxy measurement of the economic growth of Bangladesh namely, FDI. Both in the short-run, and in the long-run, the role of MFSs in the economic growth of Bangladesh is statistically evidenced by this study.

Table 18: Summary: Long-run Co-integrating Test Estimates

Dependent Variable: FDI											
Data Level	Independent Variable										
	B2P	CIT	COT	GP	INREM	MP	NORC	NOTT	P2B	P2P	TT
0	*		***		***	**		***			

*Note: ***, **, * represent significant levels are 1%, 5%, and 10% respectively; (0) represents level data.*

Therefore, the findings of this study justify the impact and contribution of MFS in financial inclusion and demonstrate how financial inclusion influences economic growth of Bangladesh. Based on these findings, regulators and policymaker can strengthen MFS accessibility in rural areas, boost usages of MFS for remittance, link MFS with economic growth schemes, and help people in rural areas develop digital skills so that they can contribute to the economy and promote economic growth.

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6.1.1 Theoretical Contribution

The research is beneficial to theory because it reveals that financial inclusion is a complex concept whose particular MFS activities affect differently. Contrary to previous studies based on the generic access pointers, our discussion indicates that transactional elements of P2B, NOTT, MP, COT, and INREM have different short and long-term impacts on economic growth. This contributes to the theoretical knowledge by proving that digital financial services are executed by differentiated mechanisms, as opposed to a uniform course.

Second, the research empirically confirms a two-stage connection between linking to MFS expansion to financial inclusion, which in turn facilitates economic growth, expanding previous conceptual frameworks in financial intermediation and digital finance (Chatterjee, 2020). Through application of ARDL, the study also explains how these relationships evolve over time with some MFS aspects having direct, short-term effects on growth and some having indirect, long-term effects. Collectively, these findings narrow the previous theory of the role of digital financial ecosystems in macroeconomic development.

6.1.2 Managerial and Policy Implications

The results have a number of implications in the form of practical implications of MFS providers, financial institutions and policymakers. To begin with, NORC, NOTT, P2P, and P2B have very strong implications on FDI, which implies that the process of registering more accounts and diversifying the types of transactions can promote economic growth. MFS providers are thus encouraged to expand service accessibility, in particular, in rural and underserved areas, and incorporate additional business-orientated digital payment products.

Second, as the impact of merchant payments (MP), and inward remittances (INREM) have substantial long-run growth effects, regulators ought to increase the strength of digital merchant ecosystems and encourage the use of cheap, secure MFS-script remittance systems. Digital financial participation can also be further enhanced through partnerships between MFS operators and SMEs as well as payroll systems.

Lastly, cash-out transactions (COT) correlate negatively with other variables (long-run), which highlights the necessity of cash-light behavior policies, including digital incentives and financial literacy programs. Niche training, particularly among women and rural users, can also be used to address lack of use and make the digital financial system more inclusive and open to more users in a more equitable way.

6.2 Conclusion

Mobile Financial Services (MFS) have transformed the landscape of financial access in Bangladesh by offering convenient, technology-driven alternatives to traditional banking channels. Using data from December 2018 to March 2024, this study empirically demonstrates that MFS plays a substantial role in expanding FI across different user groups—men, women, and underserved populations—through the steady growth of agents, accounts, and transaction

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volumes. Paired t-test results across three time periods further confirm that these improvements are both statistically significant and structurally consistent.

Beyond inclusion outcomes, the study investigates how MFS-driven financial inclusion translates into economic growth, using Foreign Direct Investment (FDI) as a proxy. Employing ARDL, Bounds testing, and ECM techniques, the study shows robust short-run and long-run associations between key MFS variables and FDI. While indicators such as registered clients (NORC), total transactions (NOTT), P2P and P2B transactions, inward remittances (INREM), and merchant payments (MP) exhibit strong growth effects, the results also reveal heterogeneous impacts across transaction types. These nuances highlight that FI is not a uniform construct; rather, it operates through different channels and mechanisms, each with varying temporal influence on economic outcomes.

By identifying these multidimensional pathways, the study contributes to existing theoretical frameworks on financial intermediation and digital finance. It demonstrates a two-stage process—MFS expansion → financial inclusion → economic growth—that both supports and extends previous conceptual literature. The findings also generate actionable insights for policymakers and industry stakeholders. Strengthening rural MFS penetration, incentivizing digital merchant ecosystems, facilitating MFS-based remittance channels, and promoting digital literacy can amplify the economic benefits of mobile finance while fostering a more inclusive financial system.

In conclusion, this research provides strong empirical evidence that MFS is an essential driver of both financial inclusion and economic development in Bangladesh. As the adoption of digital financial services continues to rise, sustained policy support and targeted managerial actions will be critical to unlocking their full potential. Future research may further explore user behavioral patterns, sector-specific digital finance impacts, and regulatory innovations to deepen the understanding of how MFS can catalyze Bangladesh's broader economic transformation.

Future studies could explore sector-specific effects of MFS (e.g., agriculture, healthcare), user behavior and trust factors influencing digital adoption, and the role of regulatory frameworks in shaping transaction patterns. Incorporating micro-level household/firm-level data could also reveal deeper insights into how FI benefits different demographic groups. Finally, comparative studies across South Asian economies would help determine whether Bangladesh's experience aligns with or diverges from broader regional digital finance dynamics.

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Appendix Table 19: Optimum Lag Selection for ARDL Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	493.3374	NA	3.16e-24	-20.05573	-19.58792	-19.87894
1	872.5167	552.9699	2.07e-28	-29.85486	-23.77346*	-27.55669
2	1095.867	214.0440*	2.51e-29*	-33.16112*	-21.46612	-28.74156*

Appendix Table 20: Test of Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.614050	Prob. F(25,22)	0.8803
Obs*R-squared	19.72785	Prob. Chi-Square(25)	0.7610
Scaled explained SS	2.774892	Prob. Chi-Square(25)	1.0000

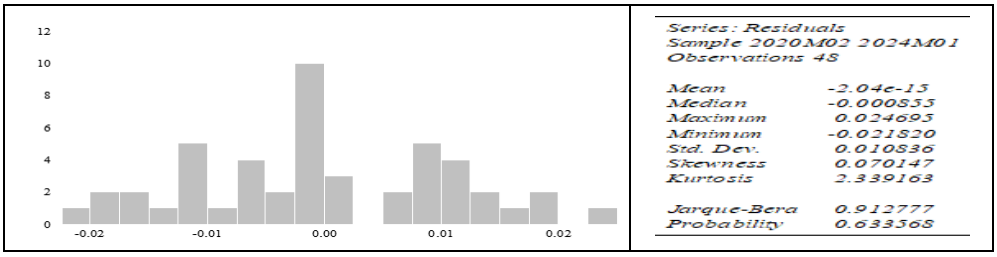
Appendix Table 21: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.753431	Prob. F(2,20)	0.4836
Obs*R-squared	3.363083	Prob. Chi-Square(2)	0.1861

Appendix Table 22: Ramsey RESET Test

	Value	df	Probability
t-statistic	2.474667	21	0.0219
F-statistic	6.123978	(1, 21)	0.0219
Likelihood ratio	12.28299	1	0.0005



Appendix Figure 7: Residuals' Normality Test of ARDL Model

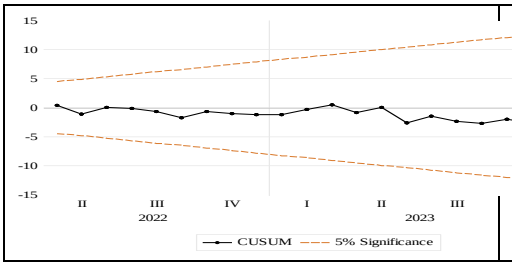


Figure 8: CUSUM Test

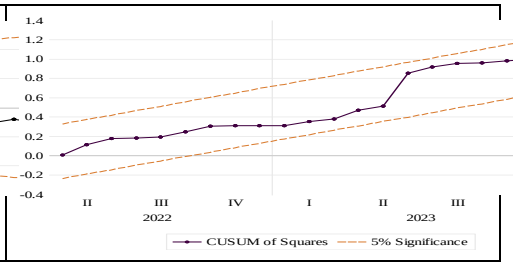


Figure 9: CUSUM of Square (CUSUMSQ) Test

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Exploring the Benefits of Artificial Intelligence Adoption in Ready-Made Garment Industry of Bangladesh

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Abstract: *This study investigates the transformative potential of Artificial Intelligence (AI) technologies—including Machine Learning (ML), Expert Systems (ES), Decision Support Systems (DSS), Optimization Systems (OS), Image Recognition and Vision (IRV), Deep Learning (DL), and Neural Networks (NN)—in Bangladesh's ready-made garment (RMG) industry. Employing a quantitative methodology, data were collected via questionnaire surveys from 300 RMG factories using convenience sampling and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4. The results demonstrate statistically significant correlations ($p < 0.05$) among five AI technologies—ES, DSS, IRV, DL, and NN—indicating their synergistic role in enhancing operational efficiency, product quality, and sustainability within the sector. In contrast, ML and OS exhibited a negative association with industry outcomes, suggesting contextual limitations in their current implementation. These findings provide empirical evidence for RMG stakeholders to prioritize AI tools with proven efficacy, while reevaluating the adoption strategies for ML and OS to address potential implementation barriers. The study contributes to the emerging discourse on AI-driven industrial transformation in developing economies, offering actionable insights for policymakers and industry leaders in Bangladesh's RMG sector.*

Keywords: *Artificial Intelligence (AI) tools, Benefits, Opportunities, Apparel Industry, Bangladesh.*

1. Introduction

The readymade garments (RMG) sector serves as the backbone of Bangladesh's economy, accounting for 84.21% of total exports ($35.81 billion) and employing over 4 million workers (BGMEA, 2022). While the "Made in Bangladesh" label has cemented the country's position as a global apparel leader, the industry faces significant challenges in managing variable costs - particularly labor, material

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handling, and supply chain overheads - making AI adoption critical for maintaining competitiveness. Leading manufacturers are already implementing Industry 4.0 solutions: Mohammadi Group's automated knitting machines, DBL Group's intelligent dyeing systems, Envoy Textiles' robotic autoconers, and Beximco's AI-powered ThreadSol fabric optimization software (Fiber Fashion, 2020). These technologies demonstrate AI's potential to reduce production costs by 18-22% while improving quality control (Edlich, 2019).

For Bangladesh's RMG stakeholders to remain globally competitive, strategic AI adoption is imperative given rising variable costs—particularly in labor (38% of production costs), material handling (22%), and supply chain overheads (BGMEA, 2023). While AI optimizes these expenditures through predictive analytics and automation (18-22% savings potential), implementation challenges include high upfront investments ($250K-$500K per factory) and workforce reskilling requirements (World Bank, 2022). A balanced evaluation of these trade-offs is critical for sustainable technological integration in Bangladesh's cost-sensitive apparel ecosystem. Thus, embracing AI could be crucial for the future of Bangladesh's RMG sector, helping it navigate a complex market and ensuring resilience in the global apparel landscape.

2. Literature review and hypothesis development:

The ready-made garment (RMG) sector in Bangladesh is undergoing a significant technological revolution, with artificial intelligence (AI) emerging as a central driver of innovation across the entire apparel value chain. As global competition intensifies, industry leaders increasingly recognize AI's potential to enhance operational efficiency, reduce production costs, and improve product quality. A survey of 288 South Korean executives revealed that 80% consider AI a disruptive force with transformative potential for manufacturing sectors (Hong, 2022). This technological shift aligns with the broader Industry 4.0 framework, characterized by the integration of cyber-physical systems, IoT, and big data analytics in manufacturing processes (Nguyen et al., 2019).

AI technologies are revolutionizing quality assurance in textile manufacturing through advanced computer vision systems. Artificial neural networks (ANN) combined with nonlinear regression models have demonstrated remarkable accuracy in detecting fabric defects, achieving classification rates that significantly outperform traditional manual inspection methods (Sikka et al., 2024). These automated systems not only improve detection accuracy but also reduce inspection costs while maintaining non-invasive quality control protocols (Das et al., 2021).

The implementation of AI extends beyond quality control to optimize various production processes. Machine learning algorithms analyze historical and real-time operational data to enhance labor efficiency and workflow optimization (Kotsiantis, 2017). AI's transformative impact is particularly evident in supply chain management and product design. Predictive analytics and decision support systems enable manufacturers to optimize inventory management, reduce

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material waste, and improve order fulfillment rates (Giri et al., 2019; Noor et al., 2022). Design automation tools powered by AI streamline pattern creation and color selection processes, significantly reducing development timelines while maintaining product quality (Hassani et al., 2020). The creative potential of AI is transforming fashion design through generative algorithms that produce market-responsive patterns and enable mass customization (Ahmed et al., 2023).

AI contributes significantly to sustainability initiatives in the RMG sector. Through optimized material utilization and intelligent resource allocation, AI systems help reduce waste and improve energy efficiency (Le et al., 2019). Advanced analytics enable manufacturers to assess the environmental impact of production processes and make informed decisions about sustainable material sourcing (Khan et al., 2023).

As Bangladesh's RMG sector continues to evolve, AI adoption will play an increasingly critical role in maintaining global competitiveness. From automated production systems to data-driven design innovations, AI offers comprehensive solutions to the complex challenges facing the industry. By leveraging these technologies, Bangladeshi manufacturers can enhance their operational efficiency, product quality, and environmental sustainability while adapting to rapidly changing market demands .

2.1 Hypothesis Development

2.1.1 Machine Learning & Apparel Industry

Machine learning (ML), a critical branch of artificial intelligence, enables systems to autonomously learn from data and refine performance over time (Sikka et al., 2024). Within the apparel industry, ML significantly contributes to enhancing operational efficiency, product quality, and market responsiveness. Supervised learning models evaluate predicted outcomes against actual results, facilitating error detection and model refinement (Lloyd et al., 2013).

A key application of ML lies in sales forecasting, where algorithms assist brands in aligning inventory with consumer demand, thus reducing overproduction and stockouts (Kumar & Poonkuzhali, 2018). Additionally, ML supports trend analysis and colour prediction, allowing designers to tailor products to evolving preferences (Hsiao et al., 2017). In manufacturing, ML-based defect detection systems identify fabric flaws more accurately than manual inspection, enhancing quality control and reducing dependency on skilled labour (Ghosh et al., 2011). Moreover, ML helps predict fabric behaviour using mechanical properties, improving material selection and process efficiency (Pavlinic & Gersak, 2004). Together, these applications affirm the hypothesis that ML plays a pivotal role in advancing design, production, and sustainability in the apparel sector.

H_1: H1: Machine learning tools positively influence operational efficiency, product quality, and demand forecasting in the apparel industry.

2.1.2 Expert Systems and Apparel Industry

Expert systems, a foundational component of artificial intelligence (AI), are computer-based programs that emulate the decision-making capabilities of

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human experts by applying logical inference rules to a knowledge base (Fu et al., 2018). These systems operate on "if-then" logic structures and were first developed in the 1970s, gaining significant traction in the 1980s as a means to replicate domain-specific expertise in decision-intensive tasks (Leondes, 2001). In the apparel industry, expert systems have demonstrated substantial utility in addressing both operational and strategic challenges.

One notable application is in environmentally responsible manufacturing, where expert systems assist in selecting appropriate processes and machinery that reduce pollutant emissions and resource consumption (Metaxiotis, 2004). By simulating expert reasoning, these systems support the selection of dyeing techniques, chemical usage, and waste minimisation strategies—crucial in aligning with global sustainability standards. In fashion retail, expert systems are also used to enhance customer satisfaction through recommendation engines. By analysing customer preferences, purchase histories, and style trends, these systems can suggest personalised product options, thereby improving customer experience and retention (Wong et al., 2009). These examples collectively support the hypothesis that expert systems offer positive implications for the apparel industry by improving production decision-making, supporting sustainability, and enhancing consumer engagement.

H_2: Expert systems contribute to enhanced decision-making and process automation, thereby improving sustainability and customer satisfaction in the apparel industry.

2.1.3 Decision Support System (DSS) and Apparel Industry

Decision Support Systems (DSS), a key component of artificial intelligence, integrate mathematical models with conventional data retrieval methods to support semi-structured and complex decision-making processes (Sprague, 1980). In the context of the apparel industry, DSS plays a critical role in enhancing operational efficiency across supply chain functions. These systems facilitate real-time analysis and scenario planning, allowing stakeholders to make informed decisions regarding resource allocation, production scheduling, and inventory management (Tu & Yeung, 1997). By leveraging DSS, apparel manufacturers can evaluate alternative strategies under varying constraints, leading to cost reduction and improved supply chain performance. Furthermore, DSS tools aid in identifying process bottlenecks and optimising workflow, which contributes to overall agility in responding to fluctuating market demands (Wong & Leung, 2008). Therefore, the evidence substantiates the hypothesis that DSS tools have positive implications for the apparel industry by supporting strategic planning and operational adaptability.

H_3: Decision Support Systems (DSS) facilitate strategic planning and resource optimization, leading to improved supply chain performance in the apparel industry.

2.1.4 Optimization Systems and Apparel Industry

Artificial intelligence demonstrates considerable capability in addressing complex, multifaceted problems by employing intelligent search mechanisms

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that can identify multiple viable solutions (Luger, 1998). Among the most prominent techniques within AI's evolutionary algorithms are Genetic Algorithms (GA), gene expression programming, and genetic programming, which mimic natural evolutionary processes to optimize problem-solving (Holland, 1992). In the apparel sector, GA has found extensive application, particularly in resolving intricate scheduling and design layout challenges inherent in textile production (Guruprashad & Behera, 2009). Its adaptive nature allows for rapid responses to the fast-paced developments characteristic of the fashion industry, facilitating improved operational agility. Additionally, GA has been successfully applied to enhance garment fitting services, offering personalized solutions that improve customer satisfaction and reduce return rates (Hui et al., 2007). Collectively, these applications illustrate the capacity of GA and related optimization algorithms to streamline production processes and support innovation in the apparel industry.

H_4: Optimization algorithms enable effective production scheduling and inventory management, resulting in cost reduction and operational agility in the apparel industry.

2.1.5 Image Recognition and Vision and Apparel Industry

In the textile and apparel industry, image recognition and computer vision technologies play a crucial role in automating quality control and defect detection processes. These AI-enabled systems facilitate rapid and accurate inspection of fabrics, significantly reducing manual errors and enhancing manufacturing precision (Cushen & Nixon, 2011).

H_5: Image recognition and computer vision technologies improve quality control and defect detection, enhancing manufacturing precision in the apparel industry.

2.1.6 Deep Learning and Apparel Industry

Deep learning is an AI approach that simulates the data processing and decision-making capabilities of the human brain (Sikka et al., 2024). Initial models were created to recognize objects within small images (Samek et al., 2017). For the detection of yarn defects, deep learning systems need to understand a wide range of defect combinations (Nateri et al., 2014; Sharma & Sindhe, 2016; Gultekin et al., 2019; Czimmermann et al., 2020). These techniques are crucial for deriving meaningful design insights from fashion images (Hossain et al., 2022). In 2021, an Adaptive Neuro-Fuzzy Inference System (ANFIS) was introduced to forecast yarn tenacity and unevenness using six input parameters related to cotton fibers. This model integrates neural networks with fuzzy logic, enabling the prediction of various yarn quality metrics based on fiber properties (Das & Chakraborty, 2021).

H_6: Deep learning tools have positive implications for quality control and product development in the apparel industry.

2.1.7 Neural Networks and Apparel Industry

Neural networks are advanced computational systems that simulate the processing abilities of human brain neurons, enabling complex tasks like pattern

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recognition and predictive modeling. In the textile industry, they offer significant benefits across various functions. For example, Almodarresi et al. (2019) created a neural network-based scanner for precise color matching of reactive dyed cotton, enhancing efficiency in garment production. Moreover, neural networks forecast apparel sales, aiding brands in inventory management and production alignment with market demand (Caglayan et al., 2020). Additionally, they excel in pattern recognition, identifying trends and designs that appeal to consumers (Iqbal Hussain et al., 2020).

H_7: Neural network models positively impact pattern recognition, predictive analytics, and automated quality assessments in apparel production.

3. Objectives of the Study

The objectives of this research are:

1. To examine the current applications and usage of AI technologies in the RMG industry of Bangladesh.
2. To identify the opportunities for enhancing AI adoption in the RMG sector, considering industry-specific challenges and market dynamics.
3. To evaluate the potential practical implications of AI implementation for key stakeholders, aimed at optimizing the benefits of AI across the RMG value chain.

4. Conceptual Framework

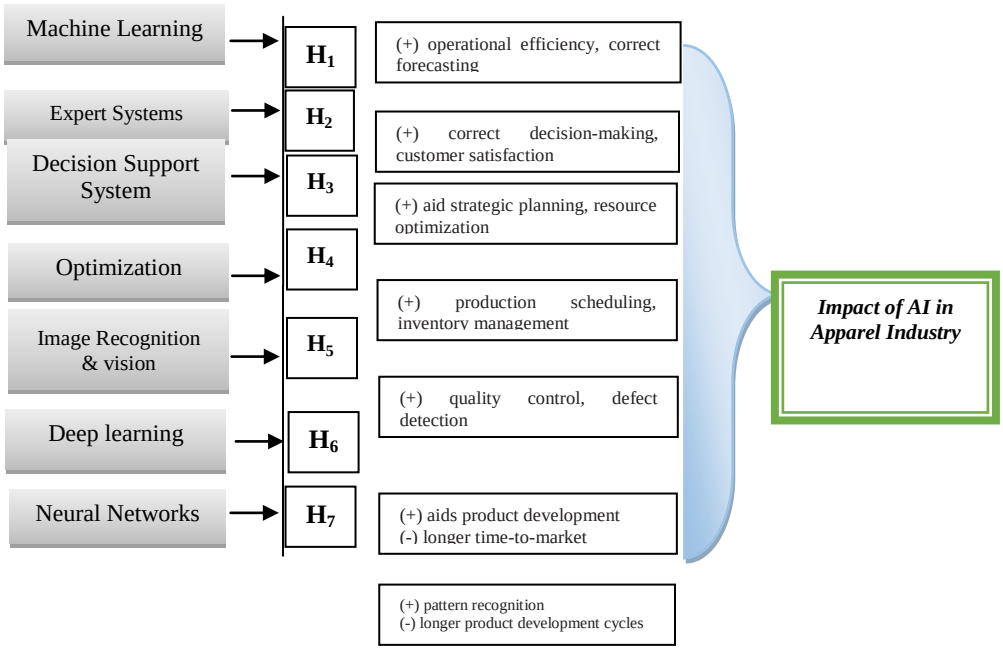

Figure 1: Proposed model for benefits of AI adoption in Apparel Industry (developed by Author)

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5. Research Methodology

5.1 Research Design, Sampling and Sample Size:

This research aims to identify the benefits of AI adoption in the apparel industry's performance using a quantitative research design. The sample size was calculated using Cochran's statistical formula (Nunnally, 1978) to ensure accurate evaluation of AI adoption and its quantifiable effects.

Where, $n = \frac{n0}{1+(n0-1)/N}$

Where, $n0 = \frac{z^2 p(1-p)}{d^2} \times (deft)$

In this formula, value of z was 1.96 which corresponds to 95% confidence level and d was set at 5% (as usual practice) and the design effect was set at 1 and p was reasonably assumed to be 0.5 as the safest procedure. Thus n0= 384.

Population N = 4498 (BGMEA, 2022)

So, the sample size $= n = \frac{n0}{1+(n0-1)/N} = \frac{384}{1+(384-1)/4498} = = 354$

RMG factories,

The study employed simple random sampling (SRS) to select 354 RMG factories from a population of 4,498, as this method ensures each unit had an equal and independent chance of selection, thereby minimizing selection bias and enhancing representativeness (Cochran, 1977). The final sample of 300 factories was achieved after accounting for non-responses and incomplete surveys, maintaining statistical power for robust analysis.

5.2 Data Analysis Technique & Measurement of Reliability and Validity

This study employs PLS-SEM to explore AI adoption benefits in Bangladesh's RMG industry, as it aligns with our predictive, exploratory goals (Henseler et al., 2016). PLS-SEM accommodates the study's small-to-moderate sample size and potential non-normal data while evaluating formative AI-adoption constructs (Hair et al., 2019). Unlike CB-SEM's strict fit requirements (Kline, 2015), PLS-SEM's variance-based approach prioritizes practical insights (R^2), crucial for this emerging research context. An initial survey was performed to assess the validity of the questionnaire, and Cronbach's alpha was employed to measure the internal consistency of the data. Items with a Cronbach's alpha value above 0.70 are considered to demonstrate good internal consistency (Guilford, 1950; Nunnally, 1978).

5.3 Questionnaire design

The study utilized a 1 to 5 rating scale for a survey assessing experiences with Artificial Intelligence (AI) in the ready-made garments (RMG) industry, where 1 means "Strongly Disagree" and 5 "Strongly Agree." It included 33 questions

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covering eight factors, such as Machine Learning, Expert Systems, Decision Support Systems, Optimization, Image Recognition and Vision, Deep Learning, Neural Networks, and the overall impact of AI. The questionnaire classified respondents by age (21 and older) and job role, facilitating accurate demographic analysis. Informed consent was obtained to ensure privacy and confidentiality, with ethical protocols in place to protect personal data and minimize harm to participants.

5.4 Items and Measurements

Table 2: Items and Measurements of the study

Serial	IVs	Serial	Items	Source
1	**Machine Learning**	i.	Sales forecasting	Kumar and Poonkuzhali, 2018
		ii.	Trend analysis,	Hsiao et al., 2017
		iii.	Color prediction	Hsiao et al., 2017
		iv.	Demand forecasting	Thomassey and Zeng, 2018
		v.	Fabric defect detection	Ghosh et al., 2011
2	**Expert Systems**	i.	Pick appropriate techniques	Metaxiotis, 2004
		ii.	Pick appropriate equipment	
		iii.	Produce less environmental contamination	
		iv.	Create a suggestion engine	Wong et al., 2009
		v	Boost client happiness	
3	**Decision Support System (DSS)**	i.	Industrialize innumerable tasks	Tu and Yeung, 1997
		ii.	Help to choose appropriate process	Wong and Leung, 2008
		iii.	Help to choose resources	
		iv.	Decrease the overall cost	
		v.	Enhance the performance	
4	**Optimization**	i.	Solve scheduling challenges	Guruprashad and Behera, 2009
		ii.	Solve design layout challenges	
		iii.	Enhance fitting services	Hui, et al, 2007
5	**Image Recognition and Vision**	i.	Inspection control	Steger, et al, 2018
		ii.	Process control	
		iii.	Content-based image retrieval systems	

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Serial	IVs	Serial	Items	Source
		iv.	Virtual try-on	Cushen and Nixon, 2011
		v.	Augmented reality	
6	**Deep Learning**	i.	Extract valuable design information from photos	Das and Chakraborty, 2021
		ii.	forecast various yarn quality metrics	
		iii.	Provides allowable values	
7	**Neural networks**	i.	Evaluate dimensional changes in the fabrics	Kalkanci et al., 2017, Caglayan et al., 2020, Iqbal Hussain et al., 2020
		ii.	Apparel sales forecasting	
		iii.	pattern recognition	

6. Data Analysis, Interpretation & Findings

Results of data analysis presented in tables and figures. Confirmatory factor analysis (CFA) assessed construct validity and reliability. Additional metrics, including average variance extracted (AVE) and composite reliability (CR), were analyzed to validate the measurement model. These analyses ensured robust psychometric properties for the study's constructs.

6.1 Output of the Measurement Model

To determine the impact of AI tools in Apparel Industry, the study conducted analysis on Smart PLS-4 because this path analysis will help to find out the relationship between them and to make the model fit. Smart PLS helps to make the model fit and find the reliability and validity of the model.

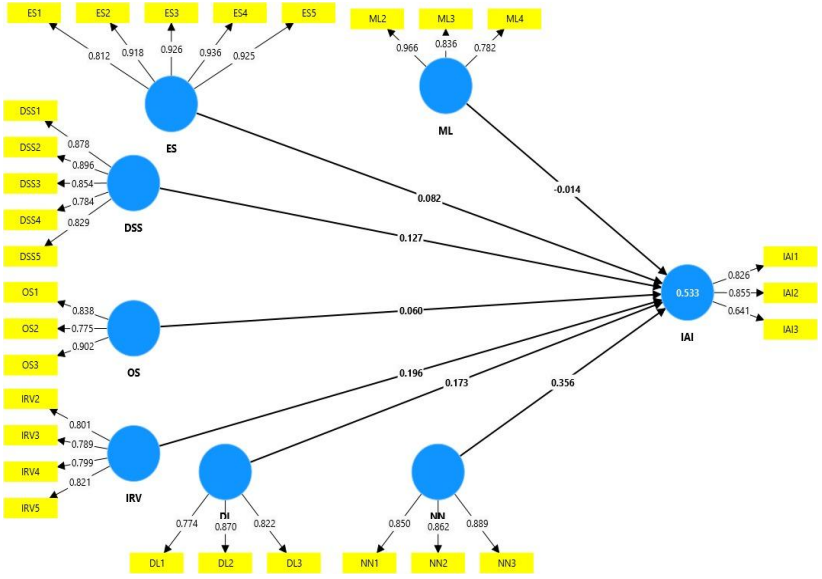

Figure 1: Graphical presentation of the PLS structural equation modeling.

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According to Chin (2010), the loading indicators of the research construct surpass a threshold of 0.60. Four indicators, namely ML1 (-0.287), ML5 (-0.399), IRV1 (0.330), and IAI4 (0.286), were excluded because their values were below the acceptable threshold of less than 0.60.From the figure, the study can say that all the AI tools have impacts on apparel industry in RMG industry of Bangladesh. All the variables have positive impact except machine learning (-0.014). The inner model suggests that Neural Networks (0.356) has the strongest impact on apparel industry of Bangladesh.

6.1.1 Reliability Test

Table 5 revealed that the value of Cronbach's Alpha (CA), rho_A value and Composite Reliability (CR) FOR ALL constructs were higher than the recommended value of 0.70 (Chin, 2010, Dijkstra and Henseler, 2015). Therefore, the result confirm that the reliability of the constructs has been well established through these perameters. The table further indicates that the average variance extracted (AVE) exceeded the recommended threshold of 0.50 (Hair, et al, 2014) and loading factors were greater than 0.60. Thus, it is quite obvious from these results that all these measures confirmed the convergent validity of the constructs.

Table 5: Reliability & Convergent validity Analysis Outputs

Constructs	Items	Loading score	Cronbach's Alpha	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Machine Learning	ML2	0.966			
	ML3	0.836			
	ML4	0.782	0.858	0.899	0.749
Expert Systems	ES1	0.812			
	ES2	0.918			
	ES3	0.926			
	ES4	0.936			
	ES5	0.925	0.944	0.957	0.818
Decision Support System	DSS1	0.878			
	DSS2	0.896			
	DSS3	0.854			
	DSS4	0.784			
	DSS5	0.829	0.903	0.928	0.721
Image Recognition and Vision	IRV2	0.801			
	IRV3	0.789			
	IRV4	0.799			
	IRV5	0.821	0.815	0.878	0.644

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Constructs	Items	Loading score	Cronbach's Alpha	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Deep Learning	DL1	0.774			
	DL2	0.870			
	DL3	0.822	0.762	0.863	0.678
Neural networks	NN1	0.850			
	NN2	0.862			
	NN3	0.889	0.835	0.901	0.752
Optimization Systems	OS1	0.838			
	OS2	0.775			
	OS3	0.902	0.795	0.877	0.705
Impact of AI in Apparel Industry	IAI1	0.826			
	IAI2	0.855			
	IAI3	0.641	0.700	0.821	0.608

Confirmatory factor analysis is employed to evaluate reliability and validity. The results of the convergent validity assessment are presented in Table 5. "The validation of measurement models through Average Variance Extracted (AVE) and Composite Reliability (CR) is fundamental to assessing AI adoption in Bangladesh's RMG industry. Following Fornell and Larcker's (1981) criterion, AVE values exceeding 0.50 establish convergent validity, confirming that latent constructs (e.g., perceived AI benefits, organizational readiness) are sufficiently represented by their indicators. Similarly, CR scores above 0.70 (Hair et al., 2019) ensure internal consistency, demonstrating that survey items cohesively measure their intended theoretical constructs. These psychometric standards are particularly crucial in technology adoption research.

6.1.2 Discriminant Validity test:

Construct validity represents a fundamental psychometric property that evaluates whether an instrument adequately measures the theoretical construct it purports to assess (Hair et al., 2019). Within this framework, discriminant validity was empirically examined using the Fornell-Larcker criterion (Fornell & Larcker, 1981), as presented in Table 6. This methodological approach requires that the square root of the average variance extracted (√AVE) for each latent variable must be greater than its highest correlation with any other construct in the measurement model (Henseler et al., 2015).

Each √AVE value (diagonal elements) exceeded all corresponding inter-construct correlations (off-diagonal elements). However, IAI-NN Correlation (0.647) approaches IAI's √AVE (0.780), suggesting marginal discriminant validity and DL-NN (0.654) and DL-IRV (0.637) correlations are moderately high but still below DL's √AVE (0.823). This indicates, IAI and NN may require further

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refinement (e.g., removing overlapping indicators) due to their high correlation (0.647). ML's negative correlations suggest it measures a distinct dimension compared to other AI tools.

Table 6: Fornell -Larcker Criterion Analysis Outputs for discriminant validity test

	DL	DSS	ES	IAI	IRV	ML	NN	OS
DL	**0.823**							
DSS	0.439	**0.849**						
ES	0.112	0.048	**0.905**					
IAI	0.607	0.462	0.144	**0.780**				
IRV	0.637	0.448	0.043	0.587	**0.802**			
ML	-0.084	-0.041	0.166	-0.051	-0.05	**0.865**		
NN	0.654	0.435	0.037	0.647	0.585	-0.093	**0.867**	
OS	0.183	0.206	0.294	0.199	0.189	0.191	0.064	**0.840**

Table 7: Heterotrait- Monotrait Ratio (HTMT) Matrix Analysis Outputs

	DL	DSS	ES	IAI	IRV	ML	NN	OS
DL								
DSS	0.526							
ES	0.132	0.052						
IAI	0.846	0.576	0.184					
IRV	0.808	0.521	0.081	0.784				
ML	0.106	0.085	0.184	0.053	0.067			
NN	0.808	0.498	0.051	0.856	0.709	0.102		
OS	0.229	0.249	0.315	0.273	0.231	0.217	0.074	

The HTMT statistical results (Table 7) show values below 0.85, confirming discriminant validity according to the HTMT threshold of 0.85 (Henseler et al., 2015). In summary, the satisfactory results for both convergent and discriminant validity collectively support the foundation for validating construct validity, as construct validity encompasses both types of validity.

6.2.3 Structural Model

This study employed various statistical metrics to evaluate the structural model and understand variable relationships (Ali et al., 2018; Hair et al., 2014). Hair et al. (2021) validate bootstrapping as the gold standard for significance testing in PLS-SEM, especially for exploratory AI studies. In addition, Sarstedt et al.

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(2022) emphasize bootstrapping's reliability for AI/Industry 4.0 research, noting its superiority over parametric tests for complex models. PLS-SEM analysis was conducted at a significance level of 5% ($P < 0.05$) for two-tailed t-tests, as Sarstedt et al. (2022) explicitly endorse the use of two-tailed t-tests (at $p < 0.05$) for hypothesis testing in PLS-SEM, including bootstrapped confidence intervals. Following established statistical conventions (Hair et al., 2019), null hypotheses (H_0) were rejected when p-values derived from bootstrapped t-tests fell below 0.05 ($p < \alpha$), indicating statistically significant relationships between constructs. Conversely, p-values exceeding 0.05 ($p > \alpha$) warranted retention of H_0 , suggesting insufficient evidence for hypothesized effects.

6.2.4 Model Fit

The model fit has been assessed by **Standardized Root Mean Square Residual (SRMR) and** R^2. In this case, the model fit is acceptable, as indicated by the R^2 value of 0.533. Hair et al (2014) argued that the R^2 value more than 0.50 represents the moderate relationship for model fit. Additionally, the SRMR value is 0.06 which is less than 0.08. Hair et al (2014) claimed that SRMR value should be less than 0.08 to ensure the model fit of PLS SEM. In this case, the SRMR value also indicates how well the PLS-SEM model fits the independent and dependent variables.

Table 8: Outputs of the Structural Model for Testing Hypothesis

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|) (β)	P values	Decision
DL -> IAI	0.173	0.172	0.084	2.058	0.040	Supported
DSS -> IAI	0.127	0.131	0.058	2.201	0.028	Supported
ES -> IAI	0.082	0.083	0.042	1.975	0.048	Supported
IRV -> IAI	0.196	0.197	0.06	3.261	0.001	Supported
ML -> IAI	-0.014	-0.015	0.049	0.282	0.778	Not Supported
NN -> IAI	0.356	0.351	0.075	4.756	0.000	Supported
OS -> IAI	0.06	0.063	0.041	1.469	0.142	Not Supported

The standardized beta coefficients (β) quantify the strength and direction of relationships between AI technologies and apparel industry outcomes, while significance levels (p-values) confirm their statistical reliability. The extraordinarily high t-statistics for IRV→IAI ($t=3.261$, $p=0.001$) and NN→IAI ($t=4.756$, $p<0.001$) demonstrate these technologies have both strong effect magnitudes ($\beta=0.196$ and 0.356 respectively)

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7. Discussion on Findings

The study examines the differential impacts of artificial intelligence (AI) tools on Bangladesh's apparel industry, conceptualizing their benefits as multi-dimensional exogenous constructs and their aggregate influence as a single-dimensional endogenous construct termed Intelligent Apparel Integration (IAI). Contrary to expectations, generic machine learning (ML) applications demonstrate no statistically significant effect ($\beta = 0.282$, *p* > 0.05), suggesting limitations in their current deployment or adaptability within the sector. In contrast, specialized AI technologies exhibit robust positive associations with IAI: expert systems ($\beta = 1.975$, *p* < 0.05), decision support systems ($\beta = 2.201$, *p* < 0.05), image recognition and vision ($\beta = 3.261$, *p* < 0.01), deep learning ($\beta = 2.058$, *p* < 0.05), and neural networks ($\beta = 4.756$, *p* < 0.001) all achieve significance, with t-statistics for IRV (3.261) and NN (4.756) surpassing critical thresholds for *p* < 0.01 and *p* < 0.001, respectively (Hair et al., 2023). The latter's t-value, coupled with a negligible probability of chance (*p* < 0.0001), underscores neural networks' exceptional role in driving industry transformation. Standardized coefficients (IRV: $\beta = 0.196$; NN: $\beta = 0.356$) further corroborate these tools' moderate-to-strong practical relevance, particularly in automating and optimizing garment production processes. With an R^2 of 0.533, the model explains 53.3% of IAI's variance, indicating substantial predictive power (Hair et al., 2014). These findings collectively suggest that while broad ML frameworks remain peripheral, targeted AI adoption— especially neural networks, computer vision, and decision-support tools—holds significant potential to enhance operational efficiency and global competitiveness in Bangladesh's ready-made garment industry.The study identifies strong positive correlations among five AI tools—Expert Systems, Decision Support Systems, Image Recognition and Vision, Deep Learning, and Neural Networks—in their impact on the Bangladeshi apparel industry. In contrast, Machine Learning and Optimization Systems showed no significant correlation. These findings align with earlier research (Sharmin, 2022; Hassani et al., 2020) and suggest that effectively utilizing AI in supply chain management, design, and production can help Bangladesh maintain its competitive edge in the global market. AI-enabled clothing design has reduced costs, increased efficiency, and addressed issues of human accuracy and quality variance, while predictive analytics can enhance demand forecasting, reduce overproduction, and promote sustainability in the sector. Surprisingly,The study reveals that Machine Learning and Optimization Systems have a limited impact on the Bangladeshi apparel industry. Despite AI's potential for solving complex problems, these tools do not significantly influence the sector.

8. Practical Implications

The study's findings present critical insights for industry stakeholders by delineating which AI technologies offer measurable benefits versus those requiring cautious implementation. For manufacturers, the strong performance of

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expert systems ($\beta = 1.975$, $p < 0.05$) underscores their value in automating compliance processes and customer service operations, directly addressing pain points in labor regulation adherence and export market responsiveness. The significant impact of Decision Support Systems ($\beta = 2.201$, $p < 0.05$) highlights their transformative potential for supply chain management, enabling data-driven procurement and logistics decisions that could enhance Bangladesh's competitiveness against regional rivals.

Optimization algorithms emerge as vital tools for tackling chronic inefficiencies, particularly in production scheduling and inventory management. Their implementation could substantially reduce fabric waste and idle capacity—key cost factors in an industry operating on thin margins. While deep learning shows promise for quality control ($\beta = 2.058$, $p < 0.05$), the rejection of related hypotheses suggests manufacturers should focus on tailored applications, such as defect detection models trained on localized production issues rather than generic computer vision solutions.

The lack of significant impact from generic machine learning and neural networks carries important implications for technology investment strategies. This finding suggests that industry stakeholders—including factory owners, trade associations, and government bodies—should prioritize proven technologies while adopting a measured approach to emerging tools. For policymakers, these results emphasize the need for targeted AI literacy programs and infrastructure development to support effective adoption of high-impact systems like DSS and expert systems.

Collectively, these insights provide a framework for strategic AI integration that aligns technological capabilities with the sector's operational realities. The findings caution against broad, indiscriminate technology adoption while identifying specific areas where AI can deliver immediate, measurable benefits to Bangladesh's apparel industry. This evidence-based perspective enables stakeholders to make informed decisions that balance innovation with practical implementation challenges.

9. Limitations & Future Agenda of the Study

This research has several limitations that warrant consideration. First, the sample size of 300 respondents may not fully represent Bangladesh's apparel sector, potentially affecting generalizability. Second, reliance on self-reported surveys introduces possible response biases. Third, the limited number of referenced studies and restricted access to current industry data may have constrained the depth of analysis. A notable conceptual limitation emerges from the findings on Machine Learning (ML). While ML as a broad category showed no significant impact ($\beta = 0.282$, $p > 0.05$), its subsets—Deep Learning (DL) and Neural Networks (NN)—demonstrated strong effects ($\beta = 2.058/4.756$, $p < 0.05$). This inconsistency suggests potential construct misclassification, as the study does not clarify whether "ML" excluded DL/NN or encompassed all ML paradigms. Future research should explicitly define these constructs to enhance

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interpretability. Additionally, the dynamic nature of both AI technologies and the apparel industry means findings may require periodic reassessment. While the study focused on AI's role, other unexamined variables could also influence sectoral growth. Beside, pproximately half of the literature were not specific to Bangladesh's apparel industry, suggesting potential limitations in the study's contextual relevance and theoretical grounding. This underscores the need for more targeted, domain-specific references in future AI/ML research on this sector. These limitations highlight opportunities for more comprehensive future research with expanded datasets and clearer theoretical frameworks.

10. Conclusion

This study systematically examined the impact of seven AI tools on Bangladesh's ready-made garment (RMG) sector. The analysis revealed significant positive correlations for Expert Systems, Decision Support Systems (DSS), Image Recognition, Deep Learning, and Neural Networks with operational improvements, while Machine Learning and Optimization tools showed negligible or negative effects. These findings highlight the need for strategic adoption of domain-specific AI technologies—particularly DSS and neural networks for supply chain optimization and quality control—rather than generic ML applications. By prioritizing high-impact tools identified in this research, Bangladesh's apparel industry can enhance efficiency, competitiveness, and adaptability in global markets. Future studies should explore longitudinal AI implementation outcomes in this sector.

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Firm Fundamentals, Market Conditions, and P/E Ratios: Cross-Industry Insights from Bangladesh

JUJBR

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Abstract: *This research explores the key contributing factor of the price earnings ratio (P/E) in Bangladesh's capital market, focusing on firm-specific, non-financial, and macroeconomic variables. A model of 81 non-financial companies from 13 industries, representing 69% of the non-financial equity market and 53% of the total market capitalization, is evaluated using descriptive statistics, correlation analysis, and panel data techniques. After undertaking model specification issues, the System GMM model discloses that P/E ratios are positively influenced by current ratio, asse size, Dividend Payout Ratio, inflation, stock market index return, and industry average P/E, while negatively impacted by debt to equity, NPM, GDP growth rate, and free float percentage. Heatmap analysis affirms valuation variances across industries and years and thus using Panel Corrected Standard Errors (PCSE) model reveals sector specific variations- Return of Equity (ROE), Dividend Payout Ratio* **(***DPR), inflation, market index returns, free float, and industry averages influence P/E differently across industries. This emphasizes investors' concentration on firm's financial health followed by macroeconomic and non-financial factors. Although the sample scope was restricted by excluding financial institutions and time periods, this is the only study in recent times that delivers a thorough multi-sector evaluation perspective for Bangladesh which will be beneficial for academicians, investors, analyst and regulators.*

Keywords: *Price earnings ratio (P/E), Panel data analysis, Firm financial factors, Non-financial indicators, Macroeconomic factors, Bangladesh capital market*

JEL Codes: *G30, G11*

1. Introduction

The stock market is a crucial economic pointer for nations, acting as an agent between savers and investors. It combines capital, spreads risk, and enables wealth transfer, while also safeguarding the efficient allocation of resources to foster economic growth (Sindhu et al., 2014). However, forecasting stock prices remains difficult for investors and fund managers, especially in dynamic markets where consistent returns are tough to achieve. This problem is especially evident in emerging economies, where stock markets often deviate from the efficient market hypothesis (EMH) (Rahman, 2019). Fama's 1970 EMH theory implies

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that both fundamental and non-fundamental elements affect stock prices. Accordingly, notable research has aimed at identifying the factors affecting stock prices in various markets (Houmes and Chira, 2015). Earlier in 2015, Adebisi and Lawal led a survey of literature that concluded that dividend per share, earning per share, book value per share, dividend payout, price earnings ratio, and size of the firm are main contributing factors of equity share price.

Stock price changes are induced by both intrinsic and extrinsic factors (Sindhu et al., 2014). Quantifiable factors such as dividends, P/E ratio, market capitalization, earnings per share (EPS), return on investment (ROI), and retained earnings, along with qualitative factors including market sentiment, company announcements, government policies, and political events, altogether play a crucial role in stock price determination. Key internal and external factors affecting stock prices include the P/E ratio, stock rumors, demand, economic conditions, and shifts in government policies. Kurihara and Yutaka (2004) also detected that macroeconomic variables such as GDP, interest rates, and employment levels influence daily stock prices. The figure 1 illustrates how average P/E ratios fluctuate widely between 2016 and 2022 across industries in Bangladesh. Thus, the debate on the factors affecting stock prices remains central to financial research.

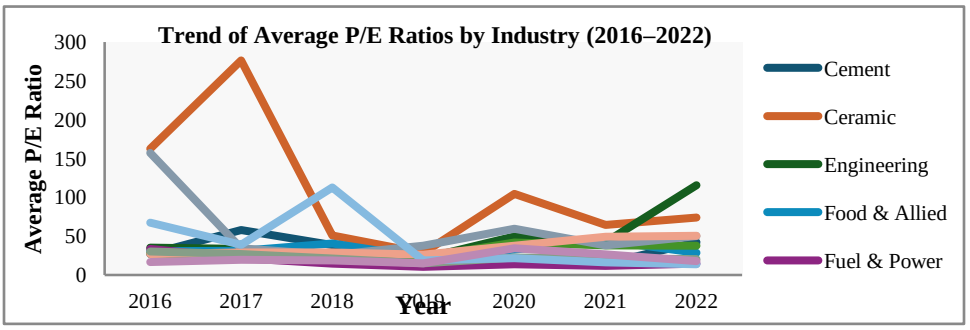

Figure 1: Average P/E ratios trend of different industries in Bangladesh

The ceramic and miscellaneous sectors showed severe instability in 2017 where other industries like Cement and Food & Allied were somewhat stable with moderate fluctuations. Engineering, Pharmaceuticals & Chemicals exhibited steady rising trends implying investor confidence and earnings resilience. In contrast, Fuel & Power sector showed a steady decline, displaying weaker growth expectations or earnings pressure. Overall, the figure hints that pattern needs to be tested with its underlying determinants of P/E across industries. Prior studies on P/E ratio determinants in Bangladesh mainly directed on industry specific or time period specific samples without thorough analysis across the entire market with cross-industry data. This study mitigates this gap by analyzing both firm specific and non-financial factors, and macroeconomic factors for non-financial firms with comparisons at the sector level. The conclusions accelerate our combined understanding of how valuation determinants vary at the firm

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level, macroeconomic level, and industry-level magnitude, and in the context of an emerging market. These identifications can help shape targeted strategies for investors, aid corporate managers to develop financial policies respecting the interests of investors, and support regulators to promote viable, efficient, and sustainable development and growth of the Bangladeshi capital market.

2. Review of Literature

2.1 Theoretical review:

The theory of using the price earnings ratio for investment analysis dates to Graham and Dodd's initial work in 1934, where they proposed it as a reflection of both past earnings and potential growth prospects. Nicholson (1960) later provided empirical support, exposing that firms with lower P/E ratios often beat those with higher ratios in terms of returns, a pattern commonly identified as the value premium. Scholars often use the Gordon constant dividend model to explore factors influencing the P/E ratio. According to this, investor returns come from dividends and expected capital gains.

2.2 Empirical review:

Firm fundamental information plays a vital role in explaining a stock price movement over time (Shao et al.,2021). Nearly 20% of the annual return can be explained by earnings announcement returns, according to their study on the effect of firm fundamental knowledge in elucidating stock returns. In a different study, Naknok (2022) used 513 observations from 2016 to 2020 to analyze 100 listed companies in Thailand. While countless valuation formulas exist, the P/E ratio remains the most used metric for estimating a stock's price relative to its earnings. It also makes it easier to predict growth, as lower P/E values often signal expectations of rising future earnings, whereas higher P/E ratios may indicate slower growth (Freihat, 2019).

In both developed and developing countries, the P/E ratio has been widely examined using various proxies. Empirical evidence from developed countries, such as the US market signifies that the P/E ratio signals investor views of a company's earnings quality. Siegel and Shim (1981) found that firms with higher-quality earnings tend to have higher P/E ratios. Regression analysis of earnings quality factors and P/E ratios support this link. Antalovschi and Cox (2021) studied 578 Canadian firms listed on the Toronto Stock Exchange between 2011 and 2018 to uncover the financial factors influencing P/E ratios in Canada. Among the 27 financial indicators employed as independent variables in the study, net profit margin (NPM), return on investment (ROI), total asset turnover (TAT), natural logarithm of total assets (ln (TA)), and dividend per share (DPS) all had statistically significant effect on P/E.

In emerging markets, different firm-level characteristics, other than earnings, have a prominent impact on the price-to-earning (P/E) ratio. In China, profitability, growth opportunities, firm size, and years listed on the market have a negative influence on P/E ratios, while circulation scale and turnover rate

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influence P/E ratios positively (Kecheng, 2022). Similarly, firm size and dividend payout positively influence P/E of Jordanian industrial firms meanwhile earnings growth, interest rate and leverage do not significantly impact P/E (Freihat, 2019). These outcomes imply firm scale, and dividends count to investor's perception of investing. In contrast, Almumani (2014) recognized P/E ratios' positive correlation with EPS, and BVPS, while negative relation to Dividend Payout (DP) and Dividends per Share (DPS), though he didn't compare or act on these relationships. Almajali et al. (2012) revealed Jordanian insurance firm performance improved with increased size, liquidity, leverage, and management efficiency. Furthermore, In Bangladesh, plethora of studies highlight important P/E ratio determinants: dividend payout, yield, leverage, liquidity, and firm size, as well as ROE and NPM (Jahan et al., 2023). Net Asset Value (NAV) and leverage exert positive influence on P/E, while dividend yield and size have a negative impact on P/E (Dutta et al., 2018). The research also signals that an investor's behavior reacts to dividends, earnings, and company-specific information (Sultana et al., 2017).

Some additional factors have been explored in both the US and UK markets such as stock liquidity, asset pricing, and free float, which suggest that the free-float-adjusted price impact ratio is superior to other measures, even during the 2007-2009 financial crisis (Le and Gregoriou, 2022). Firms with larger free float percentages in the UK are considered more liquid (El-Nader,2018). Basu's (1977) research further reinforces the notion that low P/E portfolios offer better risk-adjusted returns. In the Indonesian capital market, Alifi and Kurniawati (2024) found that earnings management negatively affects returns, while dividend policy and free float had no significant impact.

Based on these previous studies, the fundamentals of a firm are a significant predictor of its share price and valuation. Fundamentals like EPS, ROA, ROE, and book value per share (BVPS) - all have positive relationships with market value, while firm size, leverage, and dividend payout have more convoluted or negative associations altogether (Dutta et al., 2018; Freihat, 2019; Jahan et al., 2023). Non-firm related factors, such as liquidity and sentiment, are also relevant to valuation (Le & Gregoriou, 2022; Sultana et al., 2017). Therefore, the study posits the following hypotheses:

> *H_1: There exists significant relationship between the price-to-earnings (P/E) ratio and the financial performance indicators ($H_{1(a):}$ Current Ratio, $H_{1(b):}$ Debt to Equity Ratio, $H_{1(c):}$ Asset Size, $H_{1(d):}$ Return on Equity, $H_{1(e):}$ Net Profit Margin, $H_{1(f):}$ Dividend Payout Ratio) of listed companies in an emerging economy.*

Earlier, Ramcharran (2002) discussed the importance of identifying the determinants of the P/E ratio in emerging equity markets and empirically concluded that economic growth and credit risk were the most important determinants of the P/E ratio in 21 emerging markets from 1992 to 1999. In Pakistan, Khan and Amanullah (2012) found that GDP growth, dividends, and P/E ratios lead to higher share prices for 34 companies listed on the Karachi

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Stock Exchange. In comparison, Du and Li (2015) in China found a substantial association between GDP, inflation rate, and interest rate and the PE ratio in their study on the factors affecting the Baogang Group's PE ratio. In contrast, Wenjing (2008) identified industry average P/E ratio and ROE as key determinants, though macroeconomic factors had limited influence. In view of these studies, this study proposes:

> *H_2: The magnitude of influence of macroeconomic indicators ($H_{2(a)}$: GDP growth rate, $H_{2(b)}$: Weighted average lending rate, $H_{2(c)}$: Inflation rate, $H_{2(d)}$: Stock market index return) firm-level financial performance indicators and non-financial indicators ($H_{2(e)}$: Free Float percentage, $H_{2(f)}$: Industry average P/E ratio) on the P/E ratio differs significantly.*

Apart from the above discussions on existing literature, it can be easily assumed that determinants of P/E are supposed to vary across different industries and countries. For instance, Zhang (2022) highlighted that in China's media sector, the P/E ratio is strongly impacted by dividend yield, P/B ratio, ROE, and D/E ratio. Afza and Tahir (2012) identified Tobin's Q and the dividend payout ratio as the key drivers of P/E ratios in the chemical sector. Sajeetha et al. (2023) observed that dividend payout and leverage ratios positively affect P/E ratios in food, beverage, and tobacco companies in Colombo. However, returns on equity and earnings per share negatively impact P/E ratios. In Bangladesh, studies by Lalon et al. (2021), Ramij and Das (2021), and others investigated factors influencing stock prices. Ramij and Das (2021) found that ROA, BVPS, EPS, and P/E ratios positively affect insurance company stock prices. Lalon et al. (2021) showed that factors like the lagged P/E ratio and leverage significantly influence banking sector P/E ratios, while Akter and Chaity (2013) highlighted the impact of macroeconomic variables such as money supply and interest rates on share price volatility. For this reason, the study's third hypothesis attempts to examine-

> *H_3: The determinants of the P/E ratio significantly vary across different industries in Bangladesh.*

Determinants of stock prices differ from developed to developing markets. For instance, in developed economies - USA, Japan, Canada and UK - prices are determined by earning quality, return on investment and dividend consistency; with relatively low influence from macroeconomic factors (Antalovschi and Cox, 2021, Jitmaneeroj, 2017). In contrast, in emerging economies - Bangladesh, India, China, Jordan and Indonesia - valuations are more sensitive to macroeconomic drivers which include interest rate, inflation, GDP growth and money supply as well firm-specific drivers such as EPS and leverage (Du and Li, 2015, Khan and Amanullah, 2012, Lalon et al., 2021). In all cases, profitability is a universal determinant of prices; with differences in market efficiency and exposure to macroeconomic factors being the common distinction between developed and undeveloped financial systems. Research shows that current knowledge about P/E ratio determinants and their industry-specific behavior in Bangladesh's emerging market economy remains incomplete. This research aims

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to identify the main factors which determine stock price-to-earnings (P/E) multiples of companies in different Bangladeshi sectors. The study analyzes the effect of financial indicators at the company level against economic variables at the macro level and then examine how these factors influence different industries through sector-specific analysis.

Thus, it is evident that the previous studies have explored the determinants of the Price-to-Earnings (P/E) ratio in specific industries and time periods within the Bangladeshi market (Table 1). However, a comprehensive and recent analysis covering the entire capital market remains largely unexplored.

Table 01: List of study explored the P/E ratio determinants in Bangladesh

No.	Author(s)	Study period	Companies/Industry	Variables category
1	Jahan et al., (2023)	2011-2021	Banking	Financial performance indicators
2	Ramij and Das, 2021	2010-2019	Insurance	
3	Lalon et al. (2021)	2010-2019	Banking	
4	Dutta et al., (2018)	2011-2015	Manufacturing	
5	Ali (2017)	2010-2011	Random 100 DSE listed companies	
6.	Khan (2007)	2000-2006	Mixed industry	
7	Alam et al., (2016)	2006-2015	Cement	Financial performance indicators and Macroeconomic factors
8.	Akter and Chaity (2013)	2008 -2012	Banking	

This study thus minimizes that gap by examining the effects of firm-specific financial performance indicators, non-financial variables, and macroeconomic factors on the P/E ratio of non-financial firms from 13 industries, while also comparing the magnitude of determinants across industries.

3. Research Methodology

3.1 Sources of data and selection of variables:

This research draws on panel data from 81 non-financial firms listed on the Dhaka Stock Exchange (DSE), across 13 industries, for the period 2016–2022 *(Table 2).* Companies with negative EPS are not considered while selecting sample because negative P/E ratios have no usefulness for interpretation and comparability. P/E indicates a market price per unit of profit, and with losses, indicators become meaningless. Negative EPS distorts valuation signals and misleads investment decisions while also making comparisons across other firms impossible for validity in empirical research. Banks are also excluded due to the high leverage used, regulatory restrictions, and earnings that are both volatile and driven by provisions, deterioration of asset quality, and reliance on book value; as such, P/E ratios are often not meaningful when valuing banks or making relative comparisons.

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Table 02: Representation of selected sample of the study

No.	Industry	Number of companies	% of sample	Market capitalization of sample (BDT million)	Sector market cap. (BDT million)	% of Sector Market Cap
1.	Cement	2	2.47%	82,220	111,065.29	74%
2.	Ceramic	3	3.70%	25,360	32,594.73	78%
3.	Engineering	14	17.28%	124,611	525,291.89	24%
4.	Food & Allied	4	4.94%	309,765	378,604.51	82%
5.	Fuel & Power	12	14.81%	382,733	446,244.56	86%
6.	IT	5	6.17%	13,875	39,352.06	35%
7.	Miscellaneous	7	8.64%	207,597	219,432.45	95%
8.	Pharma & Chemical	17	20.99%	649,868	728,300.44	89%
9.	Services & Real Estate	3	3.70%	25,737	27,122.65	95%
10.	Tannery Industries	1	1.23%	12,304	32,671.16	38%
11.	Telecommunication	2	2.47%	423,094	580,231.79	73%
12.	Textile	10	12.35%	55,561	170,681.56	33%
13.	Travel & Leisure	1	1.23%	3,251	43,290.88	8%
	Total	**81**	**100%**	**2,315,976**		

Source: Author's own computation

Data sources include annual reports, www.dsebd.org, and investing.com. As of December 2022, the selected sample accounts for BDT 2,315,976 million in market capitalization, representing 69% of the non-financial equity market and 53% of the total equity market (BDT 4,396,721 million). To derive the variables required for this study, raw data were processed and transformed into the final indicators used in the analysis.

3.2 Description of the variables:

3.2.1 Dependent Variable:

P/E ratio: The price-earnings ratio, or P/E ratio, represents the current share price in relation to earnings per share. (Lalon et al.,2021; Ramij and Das,2021; Antalovschi and Cox, 2021; Dutta et al., 2018). The P/E ratio can be expressed based on these components.

$$(\mathrm{P/E}) = \frac{\boldsymbol{Stock\ Price\ Per\ Share\ (Po)}}{\boldsymbol{Earnings\ Per\ Share(EPS\ 1)}} \quad \textbf{----------(1)}$$

In this case, a dividend discount model may represent Po = D_1/ (r-g) and where g is the predicted growth rate of the estimated dividends, r is the amount of return that investors want, or their discount rate, and D_1 is the anticipated dividend payout for the following year. So, equation (1) can be restructured as follows:

$$(\mathrm{P/E}) = \frac{\boldsymbol{D1}}{\boldsymbol{EPS\ 1}} \mathbf{x}\ \frac{\mathbf{1}}{\boldsymbol{r-g}} \textbf{----------(2)}$$

The P/E ratio is shaped by three primary factors: expected dividend growth, firm risk reflected in the required return, and a sustainable payout ratio (Freihat, 2019). While the first two support a higher P/E, an increase in the required return lowers it.

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$$P/E = \frac{Market\ Price\ Per\ Share}{Earnings\ Per\ Share}$$

3.2.2 Independent Variables:

Current Ratio (CR): The current ratio is defined as the liabilities due within one year compared to assets that are either cash or convertible to cash within the same period. (Antalovschi and Cox, 2021; Du and Li, 2015)

$$CR = \frac{Current\ Assets}{Current\ Liabilities}$$

Debt to Equity Ratio (LR): The debt-to-equity ratio, or D/E ratio, shows how much debt a corporation has in relation to its assets. A higher D/E ratio indicates that it may be more difficult for the company to repay its debts. (Antalovschi and Cox, 2021).

$$LR = \frac{Total\ Liabilities}{Shareholders'equity}$$

Asset Size (Size): Firm size is determined using the natural logarithm of total assets (Dutta et al. 2018; Antalovschi and Cox, 2021).

$$Size = Ln\ (Total\ Assets)$$

Return on Equity (ROE): Return on Equity (ROE) is the proportion of net income generated relative to shareholders' equity, typically expressed as a percentage. (Antalovschi and Cox, 2021).

$$ROE = \frac{Net\ income}{Total\ shareholder's\ equity}$$

Net Profit Margin (NPM): Net profit margin, expressed as a percentage of revenues, indicates the amount of net income generated. (Antalovschi and Cox, 2021).

$$NPM = \frac{Net\ income}{Total\ Revenue}$$

Dividend Payout Ratio (DPR): The percentage of net income that is given to shareholders as dividends over the course of the year is shown by the dividend payout ratio (Dutta et al. 2018; Antalovschi and Cox, 2021).

$$DPR = \frac{Dividend\ Per\ Share}{Earnings\ Per\ Share}$$

3.2.3 Control Variables:

3.2.3.1 Macroeconomic Indices:

GDP growth rate (GDP GR): GDP growth, a crucial metric of economic progress, helps firms forecast industry trends and strategize for expansion. Therefore, evaluating the relationship between GDP growth rate and P/E ratio is must to understand valuation sensitivity to macroeconomic conditions. (Rahman et al., 2023; Du and Li, 2015; Wenjing, 2008)

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Weighted average lending rate (WALR): Low lending rates promote borrowing, raising company's leverage ratios and EPS; however, when rates go up, highly leveraged firms face decline in earnings and increase in stock price volatility. (Rahman et al., 2023; Akter and Chaity, 2013).

Inflation rate (IR): The PE ratio increases with rising inflation rates and decreases with falling inflation rates. (Du and Li, 2015; Wenjing, 2008)

Stock market index return (SMIR): If profit remains constant and share capital fluctuates minimally, P/E ratios will almost certainly follow the direction of the stock market index. (Wenjing, 2008)

3.2.3.2 Non-Financial Indices:

Free float percentage (FF): It indicates the portion of shares available for public trading. Institutions investors normally prefer stocks with higher free float, as low free-float stocks are typically more volatile and less liquid (Alifi and Kurniawati, 2024).

Free float percentage (FF)= [1-Sponsor director's shareholding percentage including governments holding (if any)]

Industry average P/E ratios (IAPE): Since market conditions and sector characteristics have a significant impact on interpretation and comparability, evaluating a company's P/E ratio within its industry provides suitable valuation (Wenjing, 2008; Mehta, 2025)

3.3 ***Statistical Analysis Method:***

The following multiple regression model for panel data analysis is developed:

$$\boldsymbol{P/E_{it} = \alpha + \sum_{k=1}^{6} \beta_{it} X_{itk} + \sum_{k=1}^{4} \gamma_{it} M_{itk} + \sum_{k=1}^{2} \delta_{it} N_{itk} + \varepsilon}$$

Where, $\sum X_{itk}$ represents independent variables β_{it}, represents coefficients of independent variables.

$\sum M$, represents selected macroeconomic indicators, $\gamma_{it,}$ represents the coefficients of macroeconomic indicators.

$\sum N$, represents all non-financial indicators, $\delta_{it,}$ represents the coefficients of non-financial indicators.

α is constant.

i represents the individual firms (e.g., firm 1, firm 2, ..., firm *n*)

t represents the time as a specific year (e.g., year 1, year 2, ..., year *t*)

k represents the number of total variables under each variable's category.

ε_{it} is the error term, which accounts for other possible factors that could influence but not included in the model.

Since the dataset is structured as panel data, appropriate panel regression techniques (similar to Jahan et al., 2023; Ramij and Das, 2021) after descriptive statistics, correlation analysis is applied to evaluate the research hypotheses. Diagnostic checks for heteroskedasticity, cross-sectional dependence, and

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autocorrelation, and endogeneity test are conducted. Based on the results of diagnostic tests, robust tool as applied by Lalon et al., 2021; Generalized Method of Moments (GMM) Model and Panel Corrected Standard Error (PCSE) estimation is used. Data processing and analysis were carried out using Microsoft Excel, SPSS (v27), and Stata (v14).

4. Empirical Results Analysis

The findings of each statistical technique are analyzed in the subsection below.

4.1 Descriptive statistics:

The descriptive statistics *(Appendix Table 1)* reveal that the average P/E ratio among the sampled firms is 37.33, a notably higher than the industry average of 20.69. Leverage ranges widely from 0 to 13.33. Average ROE of 14.39% and NPM of 13.26% is shown in the sample. High volatility shown by Dividend payout ratio with a mean of 61.30%. Average GDP growth is 6.65%, while the average lending and inflation rates are 8.83% and 5.96%, respectively. Free float percentages vary noticeably, ranging from 5% to 94.67%.

4.2 Analysis of Correlation among the variables:

P/E ratio shows significant negative correlation with leverage (LR), firm size, ROE, and NPM, while displaying a positive link with DPR and industry average P/E (IAPE) *(Appendix Table 2).* Macroeconomic variables display no significant correlation with P/E. Free float percentage does not have direct significant link with the P/E, it is inversely associated with most independent variables, except the current ratio. Among the controls, only IAPE has an important influence on P/E. Some moderate links were reflected among the independent and control variables, but none were strong. The mean VIF value of 1.47 *(Appendix Table 3)* indicates no multicollinearity.

Panel data analysis is performed next to investigate underlying effects among the variables.

4.3 Panel Data Analysis:

Fixed Effect and Random Effect regressions are applied to examine the panel dataset. Firms usually differ in attributes like asset size, capital, shareholder numbers, and revenue. Random Effect Model effectively portrays these cross-sectional variations. Meanwhile, the Fixed Effect Model helps control firm-specific traits that remain constant over time, thus minimizing bias. The Hausman test is applied to determine the more suitable model for this study. Similar analytical methods have been used in prior studies by Jahan et al. (2023), Ramij and Das (2021). Summary result of Random effect, Fixed Effect model and Hausman Specification effect are presented in *Appendix Table 3.*

The result of ***random effect regression*** model discloses that ROE and NPM show significant negative relationship with PE (-45.123 and-43.785 respectively); suggesting that lower market valuation multiples may be impacted from higher profitability of the firms. In contrast, both DPR and IR have significant positive

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influence on PE (27.84 and 1027.19 respectively). Other variables such as CR, LR, GDP GR, WALR have no significant effect on the PE ratio.

The result of ***fixed effects regression model*** reveals that DPR (23.25) and IR (1092.393) have significant positive influences whereas NPM (-289.08) has significant negative impact on PE ratio. These findings demonstrate investor preference for dividend disbursing firms and valuation adjustments during the inflationary periods. However, other macroeconomic and firm specific factors don't prove any statistically significant influence on PE.

4.3.1 Hausman Specification Effect:

To determine whether the unique errors (ε_i) are correlated with the regressors. *Null hypothesis (H_0):* Random effects model is appropriate (no correlation between ε_i and regressors). *Alternative hypothesis (H_1):* Fixed effects model is appropriate (correlation exists). With a chi-square value of 28.22 and Prob> chi2 = 0.0051, results favor the Fixed Effect model for this analysis. Diagnostic tests are performed next before coming to conclusion.

Diagnostic tests results summary is presented in *Appendix Table 3*. From the Wald test for group-wise heteroskedasticity, it confirms the presence of panel group-wise heteroskedasticity (Prob > chi2 = 0.0000). The Wooldridge test is applied to detect autocorrelation, with the outcome F (1, 80) = 4.289, Prob > F = 0.0416; it also confirms the presence of autocorrelation in the dataset. Pesaran's CD test (2004) result shows a p-value of 0.0000, confirming significant cross-sectional dependence. However as per VIF test, no multicollinearity is detected. Finally, according to the results of Durbin-Wu-Hausman test for potential endogeneity, LR, ROE, NPM, and IAPE are endogenous variables in the study which need to be addressed through a more robust model (GMM) for better accuracy of result.

4.3.2 Generalized Method of Moments (GMM) Model:

To address diagnosed issues such endogeneity, heterogeneity, cross-sectional dependence, autocorrelation and the dynamic nature of the relationship between firm specific factors and PE ratio; the two step system GMM estimation (Arellano -Bover/Blundell-Bond estimation) is adopted for better accuracy of result. The results, shown in *Table 3*, demonstrate that the predictor variables effectively estimate the response variable, as indicated by the low Prob > chi2= 0.0000 value. Lagged dependent variable (L1.PE) shows significant positive results which confirms the persistence of PE ratios over time. It also validates the choice of dynamic panel model. System GMM is chosen as it can generate consistent estimates in panels with large cross-sections (N) and relatively short time periods (T), while also controlling simultaneity bias and measurement errors. The result of the model can be written as follows:

$$P/E = 53.87 + 1.021CR - 12.17LR + 5.925Size - 11.76ROE - 208.85\ NPM + 22.19\ DPR - 278.79\ GDP\ GR + 99.013\ WALR + 744.09\ IR + 4.825\ SMIR - 179.67\ FF + 0.529\ IAPE + \varepsilon_{it}$$

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Current Ratio, Asset Size, Dividend Payout Ratio, Inflation Rate, Stock Market Index return, and Industry Average PE Ratio have significant positive impact on PE ratio according to the result of System GMM. In contrast, significant negative impact of Debt-to-Equity Ratio, Net Profit Margin, GDP Growth Rate, and Free Float are revealed. ROE and lending rates are statistically insignificant. Sargan test (p=0.6462) confirms the validity of instruments, second-order autocorrelation is absent as indicated by AR (2) (p = 0.7998), confirming a well-specified and robust model.

Table 3: Two Step System GMM Result

PE		*An increase of approximately 0.76 points in current PE is associated with a 10-point higher PE for last year, which demonstrates some persistence in valuations.*
L1.	0.0756** *0.0000*	
Current Ratio	1.021** *0.0000*	An increase of approximately 0.51 points for PE from a liquidity increase of 0.5 points; thus, the implication is that investors value short-term solvency more than cash liquidity.
Debt to Equity Ratio	-12.1761** *0.0000*	-12.1761 An increase of 0.1 points of leverage will reduce PE by about 1.22 points; thus, the market is not very keen on higher debt levels.
Asset Size	5.925** *0.0000*	A 10% increase in total assets (log scale) increases PE by approximately 0.59 points, indicating a small premium for larger firms.
Return on Equity	-11.7682 *0.1270*	No significant impact.
Net Profit Margin	-208.85** *0.0000*	1% increase in NPM reduces PE by approximately 2.09 points, possibly signaling limited growth potential despite profitability.
Dividend Payout Ratio	22.192** *0.0000*	5% rise in DPR increases PE by 1.11 points, indicating investors prefer dividend distribution.
GDP Growth Rate	-278.79** *0.0000*	A 1% rise in GDP growth reduces PE by ~2.79 points, possibly due to inflationary effects or rise in earnings.
Weighted Average Lending Rate	99.013 *0.065*	No significant impact.
Inflation Rate	744.09** *0.0000*	1% rise in inflation boosts PE by nearly 7.44 points, reflecting inflation pass-through in valuations.
Stock Market Index Return	4.825** *0.001*	5% rise in market return raises PE by almost 0.24 points, indicating sentiment spillover from broader market gains.
Free Float	-179.67** *0.0000*	A 5% increase in free float lowers PE by approximately 8.98 points, suggesting oversupply or volatility concerns.

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Industry Average PE Ratio	0.529** *0.0000*	5-point increase in industry PE raises firm PE by 2.65 points, showing sectoral benchmarking effects.
Constant	53.87** *0.0000*	When other explanatory variables are zero, the model predicts a PE ratio of 53.87
Sargan Stat. (Prob > chi2)	0.6462	
AR(1) Stat.	0.0452	
AR(2) Stat.	0.7998	
No. of obv.	486	
Number of groups =	81	
Prob > chi2	0.0000	

Source: Author's own computation

These findings support the $H_{1(a)}$, $H_{1(b)}$, $H_{1(c)}$, $H_{1(e)}$, $H_{1(f)}$, $H_{2(a)}$, $H_{2(c)}$, $H_{2(d)}$, $H_{2(e)}$, $H_{2(f)}$ (reject $H_{1(d)}$, $H_{2(b)}$) and prompt further examining the statement of H_3.

4.3.3 Cross industry P/E ratio influential factor analysis:

In Table 4, a heatmap visually depicts valuation differences across industries and years. Darker colors represent higher P/E ratios (overvaluation or optimism) and lighter shades represent lower P/E ratios (undervaluation or earnings strength) in the map. The Ceramic and Miscellaneous sectors exhibited exceptionally high P/E ratios in 2016–2017 (deep red zones), signaling speculative or overvalued pricing during those years. Almost all industries showed lighter colors in 2018–2019, indicating a market-wide valuation correction.

Table 4: Industry wise comparative heatmap analysis of average P/E ratio

Year	Cement	Ceramic	Engineering	Food & Allied	Fuel & Power	IT	Miscellaneous	Pharma & Chemical	Services & Real Estate	Telecommunication	Textile
2016	26.96	162.43	35.26	30.42	33.44	27.68	157.01	26.96	30.04	67.12	16.51
2017	57.58	276.29	33.29	30.87	21.32	23.78	34.21	29.1	26.95	38.88	19.22
2018	38.49	50.89	23.14	40.57	14.41	22.01	25.65	28.86	21.26	112.64	18.68
2019	19.07	28.01	21.16	22.12	10.29	22.78	37.53	26.06	14.93	18.79	14.98
2020	19.07	104.23	49.37	32.44	13.73	41.64	59.47	37.69	22.22	21.43	34.21
2021	14.48	64.48	42.18	44.12	11.67	38.11	38.08	49.15	21.48	15.99	26.58
2022	42.3	73.85	115.39	28.56	14.42	37.68	49.77	50.16	20.37	13.72	17.58

Source: Author's own computation

At the time of the covid-19 pandemic phase, Pharma & Chemical and IT sectors turned darker again, questioning strong earnings expectations and likely investor rotation into health and technology stocks-while Fuel & Power and Telecommunication remained light, questioning low valuations. As seen in subsequent periods in 2022, Engineering and Ceramic reclaimed above-average P/E ratios on the heatmaps, a good indication of sector recovery and investor interest resumed in those sectors, while once again, traditional sectors such as Textile, Fuel & Power, and Telecommunication fluctuated at low value.

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The empirical analysis in *Table 5* shows that the factors influencing P/E ratios vary across industries by employing Panel Corrected Standard Errors Model (PCSE) instead of GMM model as N <T in most industries of the selected sample which violates the preliminary assumption for GMM adoption. The Tarvel & Leisure and Tannery sectors were excluded for cross industry analysis due to limited eligible companies.

Cement: Cement industry's PE ratio is positively linked to liquidity, dividend policy and macroeconomic indicators such as inflation, stock market index return of the country. Asset size, ROE, GDP GR show negative influence. Therefore, despite capital intensity and macro volatility, investors tend to prefer dividend paying cement firms.

Ceramic: PE ratios are favorably influenced by DPR, loan rates, and industry average PE ratios demonstrate that investors prefer sector-wide performance and earnings distribution. In contrast, asset sizes have a negative influence on valuation, presumably due to inadequate utilization. The industry's susceptibility to GDP growth indicates its reliance on macroeconomic cycles.

Table 05: Cross Industry Analysis Using Panel Corrected Standard Errors Model (PCSE)

Industry		Constant	Current Ratio	Liability to Equity Ratio	Ln Asset	ROE	NPM	DPR	GDP Growth Rate	Weighted Average Lending Rate	Inflation Rate	Stock Market Index Return	Free Float	Industry Average PE Ratio	R-squared	Prob > chi2
Cement		187.29*	7.366**	-34.98**	-22.22**	-588.79**	285.89**	34.30**	-376.41**	775.44**	1167.31**	25.57**	-12.31	-0.56**	0.99	0.00
	Pvalues	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.63*	*0.00*		
Ceramic		1456.32*	-4.88	71.85	-296.63**	1190.42	1168.67	152.66**	-6726.83**	14009.51**	-88.54	-139.97**	-550.97	10.57**	0.92	0.00
	Pvalues	*0.03*	*0.85*	*0.50*	*0.01*	*0.26*	*0.45*	*0.00*	*0.00*	*0.00*	*0.93*	*0.01*	*0.08*	*0.00*		
Engineering		-184.17	34.76	-3.30	-0.77	-34.38	-710.84	-0.59	-664.20**	-859.73**	6684.07**	227.77**	106.94	-5.55**	0.26	0.00
	Pvalues	*0.05*	*0.08*	*0.25*	*0.84*	*0.73*	*0.11*	*0.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.23*	*0.00*		
Food & Allied		318.56**	-19.23*	-57.17**	-20.12**	81.96	-142.01	44.33**	-10.32	-227.23	1162.45**	35.82**	-51.04*	-3.22**	0.74	0.00
	Pvalues	*0.00*	*0.02*	*0.00*	*0.00*	*0.09*	*0.10*	*0.00*	*0.94*	*0.30*	*0.00*	*0.00*	*0.02*	*0.00*		
Fuel & Power		175.66**	-0.35	3.171**	-12.76**	-167.8**	5.88	42.63**	-8.34	-246.93*	160.75	1.27	-42.31*	-0.36	0.69	0.00
	Pvalues	*0.00*	*0.35*	*0.00*	*0.00*	*0.00*	*0.21*	*0.00*	*0.95*	*0.02*	*0.26*	*0.81*	*0.01*	*0.79*		
IT		363.20**	-9.72*	-6.60	-32.02**	-733.03**	80.07	18.58	-254.53**	164.33*	415.82**	0.59	-80.72*	0.06	0.83	0.00
	Pvalues	*0.00*	*0.03*	*0.74*	*0.00*	*0.00*	*0.25*	*0.09*	*0.00*	*0.03*	*0.00*	*0.84*	*0.02*	*0.75*		
Miscellaneous		-70.78	65.471**	35.33	-3.02	90.61	-443.01	-68.35	691.19	-1713.29	5032.14**	119.05**	-113.87	-5.799**	0.44	0.00
	Pvalues	*0.65*	*0.00*	*0.37*	*0.68*	*0.85*	*0.29*	*0.23*	*0.19*	*0.12*	*0.00*	*0.00*	*0.52*	*0.00*		
Pharma & Chemical		-157.22**	1.23	-7.821*	-8.225**	-0.57	-132.18	30.21**	1809.23**	-612.88**	9418.54**	2.04	14.15	-18.28**	0.41	0.00
	values	*0.00*	*0.06*	*0.01*	*0.00*	*0.97*	*0.06*	*0.00*	*0.00*	*0.00*	*0.00*	*0.50*	*0.33*	*0.00*		
Service & Real Esate		291.83	1.11	3.90	-29.61	-443.29*	132.84	0.61	43.89	-377.77	40.84	-13.71	66.68	0.64**	0.78	0.00
	values	*0.06*	*0.91*	*0.58*	*0.12*	*0.02*	*0.36*	*0.94*	*0.81*	*0.08*	*0.89*	*0.18*	*0.35*	*0.00*		
Telecom		-3959.73**	56.63**	-50.72**	301.60**	387.51**	-793.86*	5.54	117.28	-3606.54**	-275.69	-111.64**	5484.23**	10.54**	0.99	0.00
	Pvalues	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.92*	*0.84*	*0.00*	*0.55*	*0.00*	*0.00*	*0.00*		
Textile		-33.82	0.77	14.89**	-3.65	-118.01*	65.34	21.66**	-630.61**	699.94**	212.27**	0.41	-17.32*	2.252**	0.74	0.00
	Pvalues	*0.08*	*0.09*	*0.00*	*0.07*	*0.03*	*0.26*	*0.00*	*0.00*	*0.00*	*0.00*	*0.83*	*0.04*	*0.00*		
Travel & Leaisure, Tannery		Excluded for industry comparison as only one company is considered for overall industry														

** represents significant at the 0.05 level ** represents significant at the 0.01 level*

Source: Author's own calculation

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Engineering: Investors react positively to liquidity insignificantly and sector valuation trends negatively, while inflation also drives PE positively. Macroeconomic indicators have significant influence than firm specific factors on PE ratio of engineering sector.

Food & Allied: PE is negatively influenced by CR, LR, and FF, while it is strongly positively affected by DPR, IR, and SMIR. This reveals industry's attractiveness to investors who prioritize income and its ability to withstand inflation.

Fuel & Power: Dividends have positive impact on PE ratios, aligning with dividend signaling theory. Large firms may have capital cost tensions, as indicated by their sensitivity to lending rates. FF and ROE show detrimental effect on PE, though.

IT: Negative impacts from asset size and ROE indicate inefficient investment. IR and WALR both benefit PE, possibly due to expectations of tech-driven cost pass-through. However, FF and GDP GR rate have a negative impact on the PE ratios of IT companies.

Miscellaneous: PE is positively affected by macroeconomic variables- inflation and stock market index return but negatively affected by industry PE averages, which reflects firm specific risks dominating the valuation.

Pharma & Chemical: Macroeconomic variables (GDP and inflation) and firm specific variables DPR have a significant positive impact on PE. Negative asset size impact indicates diseconomies of scale. The high inflation sensitivity supports the cost-push theory of pricing power in keeping with the defensive stock theory.

Service & Real Estate: This sector's PE is positively influenced by industry trends and negatively with financial performance indicator-ROE. Macroeconomic forces have limited significant influence on their PE

Telecom: Telecom presents broad sensitivities in most of the variables. It identifies many important factors: profitability (ROE, NPM), asset base, WALR, and sector benchmarks (SMIR, FF) indicating complex investor valuation behavior as regards capital- intensive, regulated industries. Theoretical knowledge from market efficiency and signaling models is particularly indicative for the telecom industry.

Textile: It is directed by profitability (ROE), dividend policy (DPR), and macro conditions - WALR, accompanied by low sector benchmarks – SMIR, which reflects P/E impact from an investor perspective was focused on the importance placed on performance consistency. Inflation's positive influence aligns with cost pass-through in export-oriented markets. Firms are rewarded with efficient capital use (Asset size) and stable returns.

5. Results and Discussions

CR, size, DPR exerts a significant positive impact on the P/E ratio, while LR, ROE and NPM reveal a significant negative effect across the sample of the study.

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These findings coincide with signaling and liquidity preference theories, suggesting that investors similarly reward liquidity, scale, and dividends, while penalizing excessive leverage and high profitability that is linked to stagnant and mature, low-growth opportunities.

Among the examined macroeconomic variables, WALR has insignificant positive impact while IR poses significant positive effects, and GDP GR causes negative influence on P/E. However, non-financial indicators: SMIR, IAPE influence the P/E ratio positively and FF negatively. These demonstrate macro-financial conditions and sector standards elevate valuations, while GDP slowdowns and higher free float may dampen investor confidence and price stability.

Industry-wise analysis reveals that determinants of P/E ratio vary across sectors (support H_3). Among the firm specific indicators- most influencing variables are ROE and DPR. Positive influence of IR on P/E ratio is noted for cement, engineering, food & allied, IT, miscellaneous, pharma & chemical and textile sector. Notably, P/E ratio of cement, engineering, food & allied, miscellaneous and telecom industry are influenced by SMIR. FF significantly affects the P/E ratio in industries such as food & allied, fuel & power, IT, Telecom and textile. P/E of cement. Engineering, food & allied, miscellaneous, pharma & chemical companies tend to move reversely whereas ceramic, service, telecom and textile tend to move directly with the IAPE. These patterns are consistent with sectoral heterogeneity and behavioral finance theories which suggest that investors' perception of value varies by industry due in part to profitability signals as well as dividend policy, inflation hedging, effects of market sentiment, and liquidity effects whose implications for sector-specific investment strategies and corporate strategy.

Overall, the study confirms that firm fundamentals have the biggest impact on P/E ratios in Bangladesh out of all variable groupings, followed by macroeconomic and non-financial factors. This indicates that investors mainly look at a company's financial soundness when determining valuation. The findings of the study will add value to academics as this is the only recent study in Bangladesh that examines firm-level, non-financial, and macroeconomic determinants of P/E ratios in an integrated manner by using multi sector data set.

Table 6 presents the key findings in comparative manner with prior studies and possible logical reasons behind the result:

Table 6: Result discussion and comparative analysis with prior studies

Variable	Result	Literature Findings	Simila-rity	Possible Logical Reason
CR	Positive, significant	Positive (Almajali et al., 2012; Jahan et al., 2023)	✓	Risk aversion and a desire for solvency make liquidity valuable.
LR	Negative, significant	Mostly negative (Afza & Tahir,	✓	Financial risk is penalized for high leverage in volatile credit markets.

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Variable	Result	Literature Findings	Simila-rity	Possible Logical Reason
		2012; Khan & Amanullah, 2012)		
Size	Positive overall; mixed by sector	Mixed: positive (Freihat, 2019); negative (Kecheng, 2022)	≈	Large firms are rewarded for stability; negative sectors show mature valuation compression.
ROE	Negative / insignificant	Mostly positive (Dutta et al., 2018; Jahan et al., 2023)	✕	High profitability signals maturity, low growth; denominator effect in P/E.
NPM	Negative, significant	Positive in most studies (Dutta, 2018)	✕	Low growth is implied by high profitability; this is known as the denominator effect; investors in Bangladesh seek growth rather than steady earnings.
DPR	Positive, significant	Positive (Sezgin, 2010; Antalovschi & Cox, 2021)	✓	Dividend payout is a sign of strong governance and quality.
GDP GR	Negative, significant	Positive (Khan & Amanullah, 2012)	✕	Because of exchange-rate stress, regulatory actions, and a decline in investor confidence, GDP growth did not translate into stock market optimism.
WALR	Positive but insignificant	Negative (Du & Li, 2015)	✕	Single digit interest rate regime has distorted risk-free benchmark; profitability and leverage interacted unusually with valuation and thus investors favored liquidity and dividends over high accounting returns.
IR	Positive, significant	Positive (Du & Li, 2015; Akter & Chaity, 2013)	✓	The combination of inflation passthrough and nominal earnings effects results in higher valuation levels.
SMIR	Positive, significant	Positive (Jitmaneeroj, 2017)	✓	Market sentiment spillover effect broadens multiple via index up-trend.
FF (%)	Negative, significant	Positive (Le & Gregoriou, 2022; El-Nader, 2018)	✕	Illiquidity premium: low-float firms can capture scarcity/speculation premium, while high-float firms will be under-supplied (and will be traded down).
IAPE	Mixed (+/− by sector)	Positive peer effect (Zhang, 2022; Afza & Tahir, 2012)	≈	Capital-intensive sectors act counter-cyclically to consumer & textile sectors; thus, mixed industry P/E responses

Unlike the prior studies, it identifies industry specific drivers of valuation. Therefore, the study's findings will guide investors, analysts and regulators on how firm fundamentals and macro conditions jointly shape equity valuation. Moreover, it will also help them informed portfolio diversification choice by sectoral analysis and policy design decisions.

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6. Concluding Remarks

The research findings from GMM and PCSE analyses demonstrate that liquidity together with size and dividend payout and inflation positively affect valuation multiples in Bangladesh. The results confirm multiple emerging-market studies but show disagreement with traditional profitability-based valuation theory. The financial performance variations between the two companies result from Bangladesh's monetary conditions after rate caps and market liquidity issues and the different stages of development within their industries which influence how investor views growth potential and risk levels and earnings performance.

The study's findings on P/E ratios of Bangladeshi listed firms offer practical insights for academics, investors, stock issuers and regulators. Academics and analysts can learn new valuation drivers. Investors can estimate stock valuation, while issuers may better align IPO pricing strategies, regulators can design policies accordingly. The results can help with effective investment choices, as well as informed planning for corporate financial management. However, certain issues such as sample scope by excluding financial institutions, short time span (2016-2022) by excluding post pandemic scenario, other macroeconomic variables by not considering exchange rate volatility, political risk, investor sentiment etc. limits the study's impact. Future studies could benefit by integrating issues such as inclusion of financial companies, post pandemic analysis, corporate governance quality, exploring foreign ownership impact, investor sentiment and regulator's policy related issues; to enrich the understanding of P/E influencers.

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Appended Part

Appendix Table 01: Summary of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
P/E	567	37.33443	73.04843	4.665045	960.108
CR	567	2.315006	2.933185	0.077407	49
LR	567	1.379329	1.568177	0	13.3363
Size	567	8.933723	1.561084	5.336095	12.9752
ROE	567	0.1439507	0.208129	0.000666	1.90695
NPM	567	0.1326303	0.187193	0.002065	1.41706
DPR	567	0.6130513	0.915372	0	18.2335
GDP GR	567	0.0664766	0.013572	0.03448	0.07882
WALR	567	0.0883571	0.012452	0.0709	0.1039
IR	567	0.0596429	0.00679	0.0552	0.0756
SMIR	567	0.0730589	0.237619	-0.26423	0.54183
FF	567	0.4999854	0.194665	0.05	0.9467
IAPE	567	20.68584	8.571794	9.51	72.47

Source: Author's own computation

Appendix Table 02: Correlation Analysis

	PE	CR	LR	Size	ROE	NPM	DPR	GDP GR	WALR	IR	SMIR	FF	IAPE
PE	1.000												
CR	0.023	1.000											
LR	-.084*	-.264**	1.000										
Size	-.145**	-0.047	.366**	1.000									
ROE	-.128**	-0.068	.172**	0.055	1.000								
NPM	-.144**	.140**	.362**	.295**	.205**	1.000							
DPR	.371**	-0.031	0.024	-0.005	0.001	-0.067	1.000						
GDP GR	0.039	0.013	-0.021	0.011	-0.013	-0.006	0.059	1.000					
WALR	0.010	-0.044	0.019	.116**	-0.021	-0.029	0.074	.313**	1.000				
IR	0.035	-0.007	-0.024	-0.082	0.017	0.029	-0.037	-0.055	-.650**	1.000			
SMIR	0.020	0.063	-0.021	-0.025	0.009	0.006	-0.002	.433**	-.258**	-.100*	1.000		
FF	0.042	0.067	-.176**	-.380**	-.428**	-.139**	-.121**	-0.017	0.007	-0.036	-0.001	1.000	
IAPE	.161**	0.043	-.187**	-.227**	-0.070	-.154**	0.052	.270**	-.093*	-0.055	.451**	.165**	1.000

**. Correlation is significant at the 0.05 level (2-tailed).*

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

Source: Author's own analysis using SPSS

Appendix Table 03: Multicollinearity Test

Variable	VIF	1/VIF
Current Ratio	1.17	0.85825
Debt to Equity Ratio	1.44	0.69477
Asset Size	1.47	0.68214
ROE	1.33	0.7547
NPM	1.33	0.74914
DPR	1.04	0.95921
GDP Growth Rate	1.64	0.60887
Weighted Average Lending Rate	1.95	0.51341
Inflation Rate	1.49	0.67073
Stock Market Index Return	1.8	0.55505
Free Float	1.52	0.65947
Industry Average PE Ratio	1.46	0.68447
Mean VIF	1.47	

Source: Author's own Computation using Stata

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Appendix Table 04. Summary Results from Random,Fixed Effect model and Hausman Test with Diagnostic Tests

Dependent Variable	P/E Ratio		
Independent Variables	*Random*	*Fixed*	*Hausman Test*
CR	1.395	2.5914	chi2(6) = 28.22 Prob>chi2 = 0.0051 Fixed is accepted
LR	1.059	-3.3436	
Size	-5.351	-22.09	
ROE	-45.12*	-13.4286	
NPM	-43.78*	-289.1**	
DPR	27.84**	23.25**	
GDP GR	63.484	-1.7158	
WALR	-373.71	-165.586	
IR	1092.39*	1092.4*	
SMIR	-12.158	-9.683	
FF	-17.48	-42.498	
IAPE	0.6929	0.6063	
Constant	38.5197	218.315	
Prob > chi2	0.0000		
Prob > F		0.0000	
Diagnostic Tests	Results		Remarks
	Group-wise heteroskedasticity test (Modified Wald Test)		
Heteroscedasticity	chi2 (81) = 880000, Prob > chi2 = 0.0000		Present
	Wooldridge test for autocorrelation in panel data		
Autocorrelation	Wooldridge: F (1, 80) = 4.289 Prob > F = 0.0416		Present
	Pesaran's test of cross-sectional independence		
Cross-sectional dependence	Pesaran: CD = 24.722, Prob = 0.0000		Present
Multicollinearity	VIF=1.47		Absent
Endogeneity	Durbin-Wu-Hausman Test		
	Prob > F		Remarks
CR	0.2359		Exogenous
LR	0.0499		Endogenous
Size	0.2283		Exogenous
ROE	0.0234		Endogenous
NPM	0.0180		Endogenous
DPR	0.1692		Exogenous
GDP GR	0.6557		Exogenous
WALR	0.5890		Exogenous
IR	0.1955		Exogenous
SMIR	0.1627		Exogenous
FF	0.7080		Exogenous
IAPE	0.0001		Endogenous

Source: Author's own computation

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Transforming Learning and Development Practices to Prepare the Workforce for the Future of Work: A Qualitative Study from Bangladesh

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Abstract: *This study explores how organizations are transforming their Learning and Development (L&D) practices to strategically prepare for the future of work. A qualitative research design was adopted in the form of in-depth interviews with forty-nine HR professionals from various industries to understand the changing L&D strategies. Here, purposive sampling was employed to recruit the respondents positioned to speak directly to organizational L&D practices. To ensure sectoral variation, participants were drawn from multiple organizations within each sector. The findings show a move towards aligning L&D with wider business goals, a focus on digital skills, leadership development, and self-directed learning via e-learning platforms. Findings also reveal a shift toward integrating L&D with overall business objectives, emphasizing digital skills and leadership development. Organizations are fostering a culture that recognizes and supports continuous employee learning while increasingly linking learning outcomes with talent management and performance appraisal. Despite progress, challenges persist in the ability to quantify L&D's impact on business outcomes. The study adds new perspectives by situating global L&D trends within the context of their Bangladeshi organizational environment, which has been underrepresented in empirical research. Practically, the study demonstrates the importance of developing L&D cultures that are fit for the future in order to develop agile, future-ready workforces in the face of ongoing technological and marketplace upheaval and assist the HR professionals and management in developing inclusive learning strategies capable enough to foster employee engagement, digital capability and long-term employability in order to have both a sustainable and future-ready workforce for Bangladesh.*

Keywords: *Future of Work, Learning and Development, Transformation, Qualitative research, Bangladesh.*

1. Introduction

The global emergence of the Future of Work (FoW) is increasingly being the most important transformation for the people and the organizations (Shahriar, 2025), with the technological disruption, evolving workforce dynamics, and the shift toward more flexible, digitized, and hybrid models of employment. As work becomes more flexible, remote, and dependent on technology, it is important to focus both on innovation that ensures the sustainability of businesses and prepare

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the employees for the transformation as well. In the context of Bangladesh, this connection takes on critical significance for all, including organizations, employees, HR professionals, government and institutions. As Bangladesh transitions toward a middle- and high-income economy (Momen, 2022), the question is not merely how the nature of work is changing, but whether the future of work will be inclusive, fair, and sustainable for all. It is a fact that the country's labor market is both demographically young and economically transitional marked by the expansion of digital services, shifting employability skill sets, emergence of digital learning and increasing integration into global value chains.

Here, this paradigm shift calls for an evolution in learning and development (L&D) practices in organizations-shifting away from static training experiences and adapting to more agile (Eva et al., 2024), customized, and tech-supported learning environments (Baber, 2020). In several countries, including developing economies such as Bangladesh, this transition is critical and challenging due to various issues concerning infrastructure, policy, education systems, and organizational preparedness.

Bangladesh, with its youth population and emerging digital economy, stands at a critical juncture in its workforce development journey (Sultana et al., 2025), where organizations have to take the lead to develop their workforce according to the changing nature of work and culture worldwide (Ferreira et al., 2017). While the government and educational organizations are collaboratively working on changing the educational curriculum from primary to higher education levels, there is a huge gap between these efforts and the unmatchable speed of transformation of work (Shahriar et al., 2023). This gap highlights the need for a strategic transformation of L&D practices in the organizations that not only addresses current skill deficits but also anticipates future competencies and sustainability of the organizations.

Guiding constructs include individual learning agility and digital self‐ efficacy; despite this rich theoretical base, existing work in Bangladesh tends to treat training as discrete events, overlooks firm‐ level L&D practices to system‐ level constraints and enablers. The gap, therefore, is a cross‐ level, empirically grounded account of how L&D practices are being transformed to prepare workers for the future of work. This study addresses that gap by integrating these constructs into an inductive explanation of change processes across sectors. This specific study investigates the transformation of L&D practices in Bangladesh to meet the demands of the future of work.

This qualitative work adds an important voice to the 'future of work' discourse by turning attention toward Bangladesh, a fast-digitizing, export-oriented economy in the Global South. Future Learning and Development (L&D) systems in this region are under-researched. Instead of listing generalized skill gaps, the paper probes how firms, educators, and employees are reorganizing learning and development practices in light of automation, platform-based working, and a post-pandemic hybrid workplace.

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2. Literature Review

2.1 Arrival of Future of Work (FoW)

In recent years, the Future of Work (FoW) has garnered significant academic and policy attention (Dries et al., 2025) due to the rapid evolution of technological advancements (Bandi et al., 2020), globalization, demographic shifts, and sociopolitical dynamics (Lynn et al., 2023). Some believe this growing interest may be overhyped, pointing out that the idea of the 'future of work' is not new—after all, the future simply refers to the time that comes after the present, which has always been the case (Schoemaker, 2020). To support focused research, it is suggested that clear definitions of the terms 'future' and 'work' need to be established (Dries et al., 2025). The world is changing, and so are the ways we work and do things, as a result, work itself is evolving. To stay competitive and achieve long-term sustainability, organizations must adapt and keep pace with these ongoing changes (Shahriar, 2025).

Researchers, organizations, educational institutions, and even governments are still trying to fully understand the changing demands of the future of work (Yang et al., 2024). This is because new technologies and trends are emerging every day to reshape how work is done (Shahriar, et al., 2022). Powerful tools like artificial intelligence (AI) may even make some jobs obsolete, adding to the uncertainty and urgency to adapt (George, 2024).

2.2 FoW from concept to reality

The FoW is shaped by automation, digitization, platform coordination, global value chains, and post‐ pandemic shifts toward hybrid work (Fu, 2020). These forces change not only which skills are needed but also how skills are produced, maintained, and recognized. In emerging economies such as Bangladesh, where export sectors, SMEs, and a large informal workforce coexist, traditional, course centric training is often too slow and too detached from day‐ to‐ day tasks (Raihan, 2024). Contemporary literature therefore pivots from one‐ off training events to learning systems: organizations and ecosystems that create continuous, work embedded learning opportunities, convert informal learning into recognized credentials, and enable mobility across roles and sectors (Wang, 2025). Recent global studies indicate that technological change and new forms of work will reshape work or may even eliminate many jobs; thus, the policy response must prioritize lifelong learning for all, portable training rights, and inclusive access to reskilling (Song, 2024).

For a developing nation like Bangladesh, this highlights the need to move from episodic skill mapping, need assessment, training to learning systems that continuously generate skills (George, 2023). At the organizational level, organizational learning and dynamic capabilities frame how firms adapt L&D for turbulent contexts (Easterby-Smith et al., 2008). The dynamic capabilities view (Teece, et al., 1997) highlights sensing opportunities, seizing them, and transforming resources, capabilities that L&D can cultivate and learning happens in technology‐ mediated workplaces. Socio‐ technical systems theory

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emphasizes jointly optimizing tools, tasks, and people rather than treating technology adoption as a purely technical project.

2.3 Transformation of Learning & Development

Learning & Development (L&D) is crucial for organizational success (Ferreira et al., 2017), particularly in emerging economies like Bangladesh (Sultana, et al., 2018). Across economies, work is being reshaped by rapid digitization, automation, platform coordination, global value chains, the green transition, and shifting demographics (Suntsova, 2024). Routine tasks, manual and cognitive, are increasingly performed by software and smart machines, while remaining human tasks concentrate on problem framing, judgment under uncertainty, interaction with intelligent tools, and the social coordination of work (Babashahi et al., 2024). Concurrently, shocks like pandemics normalized hybrid and remote arrangements, requiring workers to manage time, collaborate across distance, and maintain well-being in fluid environments (Yang, Shao, & Zhao, 2025). In this context, one-off, course centric training models are too slow; organizations and education systems need continuous, work embedded learning that updates capabilities at the pace of change.

As organizations transition to digital and knowledge-based economies, L&D plays a central role in upskilling employees, enhancing workforce productivity, and ensuring business sustainability (Ellström et al., 2018). However, in 2025, rapid technological advancements, economic uncertainty, and shifting labor market dynamics have made HRD more complex (Collin et al., 2021). Thus, learning and development, human resource capacity development have been an area of interest for many researchers in recent years (Boomaars et al., 2018).

Historically, L&D was very much centered on formal classroom sessions, set schedules, and a top-down approach which concentrated on more immediate skill gaps (Shahriar et al., 2023). This world has changed with the advent of the digital economy, globalization and the requirement for ongoing reskilling in a rapidly changing work environment (Kwon et al., 2024). Learner-centric approaches with the help of Learning Management Systems (LMS) (Rajan and Natarajan, 2024), mobile learning apps (Pillai and Sivathanu, 2018), bite-sized microlearning modules, and content curated by AI have become part and parcel of today's L&D (Kumar and Mittal, 2024), to provide personalized, just-in-time learning experience to employees. Additionally, the adoption of data analytics and learning experience platforms for monitoring progress, measuring learning impact, and linking training initiatives to strategic business objectives is increasing (AlMazrouei, et al., 2024).

2.4 Designing Effective Learning and Development programs

Designing effective Learning and Development (L&D) programs requires a strategic and learner-centric approach that aligns with organizational goals and addresses the evolving needs of the workforce, in that regard, Mustafa (2013) suggested ten characteristics to design effective learning and development programs, these characteristics are

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1. Align learning and development with strategic direction
2. Control learning and development activity
3. Develop the learning and development team
4. Quantify learning and development
5. Seek external accreditation and recognition
6. Involve senior leadership
7. Establish a heightened profile
8. Integrate technology in learning
9. Model best practice
10. Move the function outside its comfort zone

Mustafa's (2013) ten characteristics for effective L&D design remain relevant today. Despite changes in technology and workforce needs, aligning L&D with strategy, involving leadership, integrating technology, and measuring impact are still essential. These principles continue to guide organizations in creating adaptive, high-impact learning programs.

Shahriar et al. (2023) found that e-learning and flexible learning options have gained significant popularity, allowing employees to learn at their own pace and apply their knowledge more effectively within the organization. Organizations are increasingly recognizing and rewarding these self-directed learning efforts (Agrawal et al., 2017), reinforcing employee motivation and aligning personal development with organizational goals (Syed and Mohd Abdul, 2023). Thus, learning becomes an ongoing, integrated part of the work environment, driving both individual growth and collective progress (Rathnasekara et al., 2025).

In this study, the author will explore these emerging trends by examining recent data to understand how employees perceive flexible, work-based, and e-learning opportunities, and how these learning approaches contribute to individual growth and organizational development.

3. Research Objective

The objective of this research is to examine how Bangladeshi organizations are responding to these changes by identifying the emerging skills required, the innovative L&D strategies being implemented, and the challenges faced in aligning learning initiatives with future workforce needs.

4. Research Methodology

A qualitative research approach was adopted for this exploratory research, as Creswell (2012) mentioned, qualitative research is particularly suited for developing an in-depth understanding of a phenomenon. As this study seeks to explore an area where limited prior knowledge exists and is exploratory in nature, a qualitative research approach was adopted. To achieve the study's objectives, qualitative data were gathered through in-depth interviews. This

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approach facilitated an open and engaging dialogue, allowing participants to share their views openly. The interviews were conducted with professionals from human resources (HR) departments across various organizations, especially those actively engaged in learning and development initiatives.

For this study, 49 HR practitioners were selected purposively based on their expertise in training, organizational culture, and implementation of learning and development initiatives, employed in diverse sectors, including multinational corporations, banks, non-bank financial institutions, and telecommunications companies, where they hold key roles in driving L&D strategies. The insights gathered from these HR professionals provided valuable understanding of current practices, challenges, and perceptions regarding employee development. The following table 1 presents the profile of the interviewees:

Table 1: Demographic distribution of the respondents

The Sample Size, N=49					
Particulars		Frequency	Particulars		Frequency
Sex	Female	28	Role	MTO-HR	1
	Male	21		Executive	6
				Senior Executive	9
Location	Dhaka	40		Assistant Manager	11
	Chattogram	9		Deputy Manager	7
				HR Business Partner	2
Type of organization	E-commerce & Retail	1		Manager	3
	FMCG	5		Senior Manager	2
	RMG	12		Assistant General Manager	1
	Telecom	4		Deputy General Manager	3
	Bank	7		General Manager	3
	NBFI*	4		Chief Human Resources Officer	1
	Advertising Agency	1			
	BPO**	4	Years of Experience	Less than 1 Year	2
	Pharmaceutical	3		1-2 Years	6
	NGO/Development	3		3-4 Years	11
	IT & Software	2		5-6 Years	10
	Healthcare Services	2		7-8 Years	13
	Transport	1		More than 8 Years	7

*NBFI= Non-Bank Financial Institution; **BPO= Business Process Outsourcing
Source: Author, Interview Analysis

The researcher personally transcribed, coded, and categorized the responses to identify recurring patterns, themes, and insights. The manual approach facilitated a deeper engagement with the data and maintained a close connection between

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the interpretations and the participants' narratives. The researcher repeatedly reviewed the transcripts to refine the themes and draw meaningful connections that contributed to value creation within the study's context.

The interviews were conducted over a period of approximately six weeks. Each interview lasted between 45 to 60 minutes, depending on the availability and engagement level of the participants. The interviews were conducted both online (via video conferencing platforms) and offline (face-to-face), based on participants' preferences and convenience. No monetary reimbursement or incentives were provided; however, participants were assured of confidentiality and were informed that their insights would contribute to advancing understanding in the field of learning and development. The data collection took place across major urban centers in the country, including Dhaka and Chattogram, where a high concentration of corporate organizations and HR professionals is present.

5. Findings

The examination of the in-depth interview data with the HR practitioners has demonstrated some significant changes in Learning and Development (L&D) practices over past years as organizations are getting future ready for the world of work.

5.1 L&D as a Strategic HR Function

82% of the HR professionals surveyed indicated that their company's L&D strategies are now connected to the company's overall mission and aligned with the company's long-term goals. It is no longer this thing that's done in spaced-out workshops or ad hoc moments; it's building this really strategic plan of mapping it to where the business wants to be in 5 or 10 years.

An HR professional working as CHRO at an RMG company mentioned that

> "*Every training we now do is mapped to a business priority—whether that's innovation, digital growth, or market leadership. If it does not advance our vision, we are not going to fund it*." -(Respondent_13- Male, CHRO-RMG, Dhaka)

This alignment includes converting strategic visions into actionable competency frameworks, emphasizing future skills such as adaptability, digital fluency, and connecting learning investments to organizational KPIs.

76% of respondents agreed that L&D is at the heart of their digital transformation. In many instances, L&D is responsible for making sure employees have the necessary digital tools, managing culture change, and onboarding new platforms like ERP, CRM, AI tools, etc.

According to 79% of those interviewed, one of the key themes that surfaced was the extent to which L&D has become integrated with talent strategy. It is the key driver in the ability to recruit, retain, and develop top talent. Companies are creating bespoke learning paths for tomorrow's leaders, succession plans, and onboarding experiences specifically for business-critical roles.

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68% of HR professionals reported that L&D teams are collaborating more closely to create or lead the development of competency frameworks. These guides facilitate the articulation of business requirements into the specific skills and behaviors common at each level.

This includes:

i. Technical and functional skill matrices
ii. Behavioral competencies aligned with culture
iii. Strategic priorities aligned to leadership capabilities

72% of respondents chose leadership development as a priority for L&D, and 80% expect to invest more in it. Instead of just developing current managers, companies today are grooming leaders of the future from the get-go in various learning styles blended learning, coaching, cross-functional projects, and time spent in innovation labs. This is linked to long-range organizational resilience, succession planning, and high-potential employees wanting to stay.

5.2 Adoption of E-learning

The adoption of e-learning was a significant change in organizational learning and development. During the COVID-19 pandemic in 2020-2022, companies faced significant challenges in maintaining their team training. That's when e-learning really took off, becoming a lifeline for remote skill development (Nair et al., 2025). It wasn't just a stopgap, though people realized online platforms were flexible, affordable, and could fit anyone's learning style. Employees started diving into self-initiated learning, from virtual workshops to hands-on simulations, to level up their skills on their own terms. At that time online training sessions, paid virtual workshops, and MOOC-based learning became very popular.

Interestingly, at the same time, organizations also started to recognize these types of skill development initiatives by the employees. Approximately 96% of respondents stated that their management genuinely appreciates employees' efforts in e-learning. Further analysis of the interviews revealed the most popular e-learning practices and their impact on business outcomes (Table 2).

Table 2: E-learning practice by employees and impact on business

Platform	Learning Approach	Popular Skills Acquired	Business Alignment	Strategic Business Impact
LinkedIn Learning	Professional, self-paced courses	Communication, Leadership, Strategic Thinking, Time Management, DEI Awareness	HR, L&D, Management, Cross-functional Collaboration	Builds leadership pipeline, improves collaboration, enhances employee engagement
Coursera	University-certified programs	Data Analytics, Project Management, Financial Planning, Sustainability, Data	Strategy, Finance, Operations, ESG Units	Data-informed decisions, project success, financial agility, ESG

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Platform	Learning Approach	Popular Skills Acquired	Business Alignment	Strategic Business Impact
		Analysis, Communication		alignment
Udemy for Business	Skill-focused microlearning	Excel, Python, Power BI, Public Speaking, Agile Methods, MS Office	Tech, Finance, Business Analysis, Operations	Improves technical capacity, empowers agile workflows, boosts productivity
YouTube	Open-access, visual learning	Presentation Techniques, Customer Service, CRM Tools, Soft Skills, Communication, Public speaking, Presentation	Customer Service, Marketing, Sales, Admin and others	Supports just-in-time learning, improves customer experience, increases brand confidence
Khan Academy	Free, academic-style modules	Financial Literacy, Basic Statistics, Logical Reasoning, Economics, Finance	Entry-level Training, Support Functions, Compliance	Strengthens foundational knowledge, reduces training costs
Microsoft Learn	Role-based technical paths	Azure Cloud Services, Microsoft 365, Cybersecurity Essentials	IT, Infrastructure, Digital Transformation	Accelerates cloud adoption, strengthens system security and operational efficiency
Internal LMS	Organization-specific learning	Company Policy, Product Training, Compliance, Culture Orientation, Operation, Manufacturing, Planning	All Departments	Ensures compliance, improves onboarding, strengthens organizational alignment
edX / FutureLearn	Academic and corporate blended	Artificial Intelligence, Sustainability in Business, Global HR Practices	Innovation, CSR, Sustainability, HRM	Drives innovation, supports long-term sustainable practices, enhances global competitiveness

Source: Author, Interview Analysis

Table 2 illustrates how employees are actively pursuing learning through common avenues of e-learning and how their training efforts correspond to business requirements. Platforms like LinkedIn Learning, Coursera, and Udemy are commonly used for a more structured learning of a specific skill. Employees are also picking up important skills in leadership, communication, data analysis, project management, and technical programs such as Excel and Python. These capabilities directly support the development of leadership capacity, efficiency of

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operations, and data-driven decision-making in areas like HR, finance, operations, and strategy.

YouTube and Khan Academy serve different purposes at free of cost. YouTube is primarily used for quick, visual learning that cuts across tools, customer service, and soft skills to help employees in all roles-sales, admin, and marketing. Khan Academy is more academically focused, helping employees brush up on basic skills, like math, statistics, and logical reasoning helpful for an entry level job or a job in support.

Microsoft Learn enables staff to achieve certifications and practical skills in digital tools such as Google Ads, Analytics, Microsoft 365, and Azure. Such tools are essential for marketing and IT, as well as digital transformation objectives. Furthermore, companies rely on internal LMS software to introduce their employees to policies, compliance standards, product information, and culture-building exercises.

Employees are learning skills that are not only beneficial for their own personal development but are also what the organization needs strategically-be it to improve the customer experience, to enable innovation, or to move forward on digital transformation.

5.3 Recognition of employee learning efforts and outcomes

Interview data from HR professionals indicated a high level of organizational commitment to support and facilitate employee-led, self-initiated learning efforts. Approximately 90% of respondents reported organizations that actively value self-initiated learning by employees-on both informal and formal levels. Recognition tools include internal newsletters, callouts in team meetings, the annual appraisal note, digital badges, and posting accolades on social media.

In this regard one of the HR managers working in one of the largest banks in Bangladesh mentioned that-

> "*That LinkedIn certificate from a recognized body or a learning platform linked with top universities — if any of our employees earn it, we don't just congratulate them inside the office. We also post about it on our company's LinkedIn page to show appreciation. It makes the employee feel valued, and at the same time, it gives a good image of our company. So, it's really a win-win for both the employee and the organization*," (Respondent-16 Female, HR Manager, Bank, Dhaka)

The interview analysis also found that such a learning culture is instrumental in reducing training costs and encouraging peer learning motivation. The workforce is becoming more responsible for its development, feeding greater independence from formal, top-down training. There is some correlation between the recognition of such efforts and higher engagement, lower attrition, and greater 'skill alignment' with the shifts taking place in the business. Just to recap, what I heard in the interviews is a definite evolution: learning amongst employees is no longer simply supported; it is heralded and magnified, and it has a key role for employer brand, skill building, and employee retention.

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The key outcome areas influenced by self-initiated employee learning and explains how organizations are leveraging these outcomes to drive both individual and institutional success (Given in Table 3).

Table 3: Self-Initiated Employee Learning outcomes

Outcome Area	Explanation of Impact
Training Cost Reduction	Reduces dependency on instructor-led training or external vendors as employees upskill through online platforms.
Faster Skill Development	Employees learn at their own pace, enabling just-in-time learning relevant to current job demands.
Motivation & Peer Learning	Recognized learners inspire others to follow suit, building a culture of shared growth and internal knowledge exchange.
Employee Branding	Employees gain visibility and credibility when they share certifications on platforms like LinkedIn.
Employer Branding	Organizations amplify these achievements via social media or intranet, showcasing a talent-driven culture.
Internal Recognition	Learners are appreciated in team meetings, newsletters, or recognition platforms, boosting morale and confidence.
Promotion & Career Growth	Certifications often contribute to internal mobility, better appraisals, or fast-tracked career paths.
Talent Retention	Recognized and engaged learners feel valued, increasing their loyalty and long-term commitment.
Alignment with Business Needs	Learning aligned with key business skills (digital tools, analytics, leadership) ensures employees are future-ready.
Employee-Led Innovation	Self-learners often bring in fresh ideas and tools they picked up from platforms like Coursera or Udemy.
Managerial Support	Supervisors and HR teams increasingly support learning by allocating time, budget, or visibility.
Inclusive Learning Culture	Recognition of all learners (junior to senior) promotes equity and a psychologically safe environment for development.

Source: Author, Interview Analysis

The effects of resourcing self-initiating learning promote clear, strategic outcomes, yet also have to be interrogated for the sake of sustainability. For

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instance, lower training costs are a key advantage now that employees are utilizing online tools to self-upskill more than ever. But without that oversight, there's a danger that learning and business needs won't be perfectly aligned. Faster skill development and peer encouragement create more of a learning culture, but less visible employees can become disengaged if they are overlooked or constrained. Although platforms like LinkedIn have empowered employees to develop personal brands, this exposure also draws interest from outside recruiters-increasing retention risk. Employer branding boon-for organizations that promote employee successes If it comes from a real place (not just when the times are good) and continues beyond the close of a new deal.

In addition, you will raise spirits, but inconsistent inspiration breeds a sense of favoritism. Credentials have become more closely linked with career advancement and promotions; however, someone who is over reliant on certifications without validated performance may lead to a lack of long-term leadership in the pipeline. Lastly, employee-driven innovation and inclusive learning cultures are two strength areas but are dependent on strong management leadership, digital access, and equal policies. Therefore, recognizing self-initiated learning is more than a celebration of accomplishment; it is a strategic means of integrating it into the overall talent development and corporate expansion process.

5.4 Data-Driven L&D and ROI Focus

The research also demonstrates the move toward a data-inclined approach to learning and development (L&D), illustrating a significant sway from top management's quest for results-driven ROI. Around 90% of HR representatives have acknowledged the growing scrutiny of training expenses and the challenge for training departments to demonstrate a return on investment. A few organizations are now using learning analytics to monitor participation rates, assessment results, or course completions, but the vast majority of respondents reported surface-level and inconsistent current evaluation systems. The emphasis usually ends at attendance and feedback surveys and fails to move beyond performance improvement, behavioral change, or business impact.

One HR professional from the banking sector stated,

> "*We track who attended and what scores they received, but we still cannot measure how this training has benefited the business or contributed to employee growth*." (Respondent-14, Female, Senior Executive-Bank, Dhaka)

Another L&D head (Manager) of an IT organization expressed,

> "*We require more robust systems to connect learning to KPIs such as sales growth, customer retention, or innovation output*." (Respondent-48, Male, Manager-L&D, IT Firm, Dhaka)

The results imply an intention for ROI measurement is there; however, the capability gap remains wide. Strong evaluation mechanisms such as data dashboards and performance-linked metrics are either nascent or inconsistently utilized.

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Many organizations also face the problem of lacking integrated HR systems and the necessary analytics capabilities to extract useful information from learning data. As a result, HR leaders are calling for investment in learning technology platforms, people analytics, and management training on how to measure the effectiveness of training, beyond attendance. If learning outputs cannot be directly linked to business outputs, L&D's strategic credibility may suffer in the eyes of business leaders.

5.5 Integration with Performance Appraisal

The findings from interviews with 49 HR professionals from various industries indicate that companies are starting to include learning and development efforts especially self-directed learning—in their official performance reviews. Although this linkage between the two is not yet prevalent everywhere, several companies are now recognizing learning accomplishments as critical evidence of employee drive, flexibility, and future prospects as employees.

Approximately 65% of respondents said their company acknowledges employees' certifications or learning accomplishments when offering performance appraisals, particularly when the learning is related to business goals or role-specific skills. This trend is particularly evident in sectors undergoing digital transformation, such as IT, banking, and telecom.

Meanwhile, around 4% of HR leaders were nervous about inconsistent execution, especially when not all managers were on board or there wasn't a strong tracking tool. Some companies still view learning as a "soft metric," relying on anecdotal references instead of scientific assessments. Others stressed the importance of clear frameworks and of digitalization, allowing more effective capturing, validation, and linking of learning data to performance.

Several respondents noted that 'learning milestones' are now included as KPIs with some milestones or developmental goals linked in for use in leadership/high potential tracks in my home unit. This reflects a change of attitude where learning is not viewed as something extra but as something that is crucial to performance and career development.

Table 4: Integration of L&D with Performance Appraisal

Integration Area	Description	Current Adoption Trend	Remarks / Critical Insights
Certification Recognition in Appraisal	Recognizing self-initiated learning (e.g., LinkedIn, Coursera) during performance reviews	Moderate to Growing	Often appreciated as a sign of initiative and commitment to growth; not always systematically tracked
Learning Milestones as KPIs	Including learning goals (e.g., course completions, digital skills) as part of KPIs	Emerging Practice	Seen in leadership pipelines and development plans; needs strong goal-setting culture

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Integration Area	Description	Current Adoption Trend	Remarks / Critical Insights
Career Progression Linked to Upskilling	Promotion or internal mobility influenced by completed learning pathways	Moderate	Helps build a learning-based progression system; must balance with performance-based promotion
Learning Summary in Self-Appraisal	Employees submit their learning activities and reflections as part of appraisal forms	Limited but expanding	Encourages self-awareness and documentation of growth; more common in creative/tech roles
Manager Evaluation of Learning Application	Managers evaluate how well employees apply newly acquired skills to real work	Informal to Formalizing	Depends on manager training and alignment with performance metrics
Points/Badges Impacting Reviews	Use of gamified systems (e.g., points, digital badges) to reward learning that feeds into reviews	Low but Piloting in Digital Firms	Seen in digitally mature firms; can drive healthy competition and recognition
Peer Validation of Learning Impact	Team or project peers acknowledge someone's learning contribution during review cycles	Rare and Experimental	Innovative, but needs trust and cultural readiness to be effective

Source: Author, Interview Analysis

The table 4 illustrates how companies are starting to integrate learning and development (L&D)-especially self-initiated learning-into performance appraisal systems. One of the most widely held practices is for HR professionals to acknowledge employee achievements, such as certifications, a clear indication for many of a commitment to enhance their skills. This integration is currently occurring in some companies, where learning is 'baked into' KPIs, particularly for high-potential employees or leaders in development.

Career development associated with upskilling is also on the rise, with promotions now more likely to take into account not only performance but also lifelong learning. A learning summary or reflection in the area of self-awareness or goal setting can be required in self-appraisal by some companies; this can help create better self-awareness and goal setting.

But higher-level practices like having managers evaluate applied learning or rewarding completion of gamified features (like badges or points) by changing performance appraisals are in their infancy and found only in digitally advanced organizations. Peer validation of learning impact is experimental and culturally bound on its trust and transparency.

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6. Analysis & Discussion

The research suggests that the value of learning and development is increasingly recognized by organizations, treating the advancement of people from 'something that is done in the margins' to a strategic, goal-oriented process that closely mirrors business objectives for growth. They don't see learning as something separate from work; they bring people development plans in line with their major strategic direction, and investments are made in skills development targeted at driving the innovation, the digital transformation, and the competitive edge that their organizations are seeking to secure. This strategic integration to focus on future readiness, however, carries with it the understanding that workforce skills need to adjust to the moving business landscapes.

HR practitioners recognize L&D as a key lever for managing digital transformation, ensuring that employees are equipped with the digital skills required and driving culture change through constant learning. In addition, the merger of L&D and talent management highlights its broader function in the organization as a tool to attract, retain, and cultivate high-potential talent. Tailored learning pathways and competency models are prime examples of how companies are dismantling strategy into specific capability requirements and leadership development—vital for building resistance in continually disrupted environments.

The rapid rise of e-learning platforms, prompted by the pandemic, represents a fundamental shift in the way employees discover and interact with learning. The widespread adoption of self-directed, digital learning signals a democratization of skill-building, in which employees drive their development and where businesses are dexterously leveraging these pursuits to fulfill the needs of the business. The variety of platforms employed emphasizes the complex nature of learning from basic skills to sophisticated digital literacies and leadership capacities, demonstrating the importance of flexible and tailored learning ecologies.

Employee learning recognition has become a key factor in developing an inclusive, success-inspiring learning culture. Recognition in the public domain in all forms not only improves personal morale and branding but also meets organizational purposes through continued alignment of growth and organizational goals. But, as with all changes in attitudes, close attention should be paid to avoid favoritism and to make efforts to ensure equal access and support for all employees.

However, organizations struggle with the ability to critically measure the value of L&D initiatives for businesses. Although some recognition exists regarding the need to factor ROI measures, current evaluation efforts are a great deal of the time prehistoric, concentrating on participation indicators instead of performance enhancement or organizational influence. This lag points to a requirement for more advanced analytics capabilities and for learning data to be integrated with wider HR and business systems to evidence the strategic value of L&D and shape resource investment.

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The use of learning achievements in formal performance management systems is slowly evolving; however, it is not yet uniform. Some businesses value certifications and learning milestones so highly that they influence employee appraisals and are linked to career paths and leadership initiatives. However, more sophisticated methods such as managers assessing applied learning, gamified rewards, and peer endorsement are nascent, demonstrating that cultural readiness and IT infrastructure are both essential drivers to wholeheartedly integrate learning into performance ecosystems.

In preparation for the future of work, organizations are focused on a complete transformation of their learning and development culture. They are moving beyond traditional episodic training to integrate continuous learning as a key feature of their ongoing business strategy. This transition entails focusing L&D programs directly on organizational goals and centering them on future-ready skills, including digital fluency, adaptability, and leadership. Through a combination of digital platforms and self-directed learning, businesses create a learning culture where employees drive their development and are empowered and valued by their employer. In addition, companies are more and more incorporating learning outcomes into performance management and talent development so that new skill acquisition can mean job advancement and business impact. This L&D culture in the making doesn't just produce a more agile workforce but a more resilient and innovative one, ready to out-thrive in the face of rapid technological and market changes.

7. Conclusion

This research indicates a massive shift in how businesses pursue learning and development strategies, navigating away from fragmented training interventions and toward systemic and strategically integrated approaches that are closely aligned with future workplace needs and business priorities. The transition towards a more agile workforce that is more competent and motivated is increasingly evident through examples such as the use of digital learning tools, focus on self-directed development, and incorporation of learning into talent management activities. Yet there are budding problems when it comes to quantifying the effect of L&D initiatives in spite of embedding these in performance systems as it should. In general, companies are well positioning themselves for future readiness by establishing a learning culture that perpetuates continuous skill evolution, leadership evolution, and infrastructure and business evolution.

8. Theoretical Contribution

The study introduces a practical explanation of how organizations in an emerging-economy context transform L&D to prepare the workforce for FoW. It reframes L&D from a set of courses to a dynamic, firm-level capability, which can be termed as work-embedded learning capability (WELC). WELC is the organization's capacity to generate, apply, and refresh skills continuously through

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the interaction of five elements: (1) strategic and technical transformation, (2) access and digital fluency, (3) track the learning and supervisory scaffolding, (4) value the learning and include in performance, and (5) recognition mechanisms, micro-credentials and recognition of prior learning that make learning visible and portable. This moves the literature beyond 'what skills are needed' toward how skills are systematically produced and renewed under real constraints.

9. Managerial implications

The study's insights point managers toward treating L&D as a core capability rather than a cost. Practically, this means linking every skills initiative to clear business outcomes, redesigning 'courses' into short, work-embedded cycles, and giving employees protected time to practice new methods on real tasks. Supervisors need simple coaching tools and accountability for follow-up so learning transfers into day-to-day routines, while teams benefit from a climate where questions and small experiments are safe. This study will also help the managers and HR to track a few lead indicators like learning time used and first-application rate alongside operating metrics that matter to each unit such as quality, turnaround time, customer outcomes. Finally, align technology, workflows, and incentives assure job aids, peer support, and role redesign, and work with external partners to keep content current and accessible for all staff, including those in smaller sites or on variable shifts.

10. Future Research Direction

Future research work might also investigate the validity of different learning analytics tools in measuring the true impact of L&D on the business results and performance of employees. Longitudinal research might explore the long-term impact of persistent investment in strategic L&D on resilience and innovation capability at the organizational level. Additionally, more research could look into the cultural and structural factors that influence how self-directed learning is adopted and used in formal performance management, particularly in diverse organizations. Investigating employees' experiences and obstacles to participating in digital learning could also inform the design of more inclusive and equitable L&D practices, which are supportive of the diversity and inclusion goals of the changing future of work.

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Exploring the Skill Gaps among Bangladeshi Graduates: A Study from HRD Perspective on Higher Education

JUJBR

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Abstract: *This study explores the skill development gaps among Bangladeshi graduates from the perspective of Human Resource Development (HRD) in higher education, also examines the mismatch between academic preparation and industry expectations, and identifies key areas of improvement to enhance graduate employability. A qualitative research approach was adopted, through interviews with 46 HR professionals and 6 academicians selected through purposive sampling. Data collection emphasized lived experiences and professional insights into the preparedness of graduates for the workforce. The findings reveal critical deficiencies in soft skills, communication, competence, professional etiquette, problem-solving, critical thinking, and real-world job readiness. Limited collaboration between academia and industry, along with outdated curricula, was identified as a major contributor to these gaps. The study recommends curriculum reform, structured soft skills training, enhanced faculty-industry engagement, and experiential learning approaches to better align higher education outcomes with the demands of a modern workforce. Future research can explore sector-specific skill gaps, student perceptions of readiness, and the long-term impact of curriculum reforms, helping to further align higher education with industry needs.*

Keywords: *Skill Development, Skill Gaps, Graduates, HRD Perspective, Higher Education.*

1. Introduction

In the era of rapid globalization, digitalization, and technological transformation, and shifting labor market dynamics, the concept of employability has emerged as a critical indicator of success for higher education institutions (Momen et al., 2022). At the same time, skilled employees are regarded as a competitive advantage and a critical source of sustainability in this rapidly changing industry (Akter et al., 2021). Across the developing world and particularly in Bangladesh, a growing tension is being observed between the output of the higher education sector and the actual demands of the relevant labor market (Sarker, 2024).

Bangladesh is currently at a demographic crossroads. With an estimated population of 175.7 million—half of whom are women—and around 115 million people in the working-age group (15–64 years), the country holds a significant opportunity to capitalize on its demographic dividend (The Financial Express,

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2025); but this dividend could quickly become a demographic burden if the young aren't equipped with the skills for success in a competitive and ever-changing job market (Shahriar et al., 2023). Reforms in higher education and youth employment have been a priority for successive administrations (Shahriar et al., 2021). But despite all this, the national statistics do not look encouraging: millions of university graduates remain unemployed or underemployed, and business leaders regularly complain that they can't find 'job-ready' candidates.

In all parts of the world, nations are facing great difficulty when it comes to matching their higher education systems to a more sophisticated labor market. In Bangladesh, the situation is more severe due to structural problems in academic planning and curriculum design, inadequacy of linkage between education and industry, and lack of a strong and coherent national HRD strategy that integrates higher education with long-term economic planning. While the country has made notable progress in increasing enrollment and expanding access to higher education, questions about the quality, relevance, and applicability of the education system remain unresolved (Momen et al., 2023). These concerns are most vividly reflected in the skill development gaps that persist among graduates, making them underprepared for the modern world of work.

This research seeks to explore this complex phenomenon by analyzing the alignment, or lack thereof-between higher education outcomes and the human resource development (HRD) needs of Bangladesh.

2. Literature Review

2.1 Changing employability skills and the shift of the Industrial Revolution

The global employment landscape is undergoing a profound transformation driven by the rapid pace of technological advancement and the evolving nature of the industrial revolution (Shahriar, 2025). As the world moves from the Fourth Industrial Revolution – with its convergence of digital, physical, and biological technologies (Wang and Siau 2019), the parameters of employability and labor market skills are changing just as fast (Ziatdinov et al., 2024). The current Industry 4.0 places a premium on competences such as data analysis, artificial intelligence, machine learning, robotics, and cloud computing, but also rewards agility, creativity, and interdisciplinary thinking (Ayandibu et al., 2021; Bagnoli et al., 2021).

But this transition isn't just about technology. Work has changed enough that soft skills, like emotional intelligence, collaboration, problem-solving, digital communication, and a capacity for learning on the fly, are as important to learning how to code as coding is (Chakrabarty, 2021). Employers today look for people whose talent is not only technical, but also a culture fit who is collaborative, a strong communicator, and open-minded when it comes to dealing with ambiguity and change (Nwaohiri and Nwosu, 2021).

Moreover, automation and AI are replacing large quantities of routine and repetitive activities, particularly in manufacturing, administration, and retail

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(Kretsos, 2025). Yet this shift is accompanied by the rise of fresh roles that draw on a mix of technical and people skills. It's just that jobs like data translator, AI ethicist, digital content creator, or experience designer (Bukartaite and Hooper, 2023) simply did not exist ten years ago.

In emerging economies such as Bangladesh, where much of the population is going to be in the working ages, it is paramount to connect education and training systems with the future of work (Yang, et al., 2024). There is an urgent need to reform curricula, integrate digital and vocational training, and encourage lifelong learning so as to prepare youth for new types of employment. Additionally, the increasing interconnectedness of the global economy and the resurgence of telework have propelled cross-cultural competence (Bilderback and Thompson, 2025), digital literacy (Perera et al., 2025), and global collaboration as key elements of Employability.

2.2 Employability Skills and Reality

Employability Skill comprises the fundamental knowledge and qualities that prepare graduates to get a job, work well, and cope with the dynamics of job requirements; these skills don't consist purely of academic knowledge but a mix of technical, cognitive, and behavioral skills needed in today's dynamic labor market from the perspective of human resource development (HRD) (Subbu Nisha and Rajasekaran, 2018). Internationally, employers and HR practitioners list essential employability skills as communication skills, problem-solving skills, teamwork skills, leadership skills, the ability to adapt, ICT literacy, and emotional intelligence (Sarfraz et al., 2018).

Within Bangladesh, higher education institutions (HEIs) concentrate more on academic or theoretical knowledge rather than hands-on, practical work-related skills. General perception of both employers and employees points to a continuing lack of soft skills, including workplace communication, time management, teamwork, and professional ethics among fresh graduates (Mwita et al., 2024). Bangladesh's higher educational system—particularly outside its major urban centers—isn't nimble or structured enough to teach these skills geared toward the future (Saari et al., 2025).

This discord between newly graduated students and market demand complicates talent identification and development paths for organizations. The HRD interventions, such as corporate trainings, internships, and industry-academia interfaces, are therefore necessary to bridge this gap. Therefore, employability skills are dynamic and changeable and breed global changes, local job market demands, and technological transformation. Thus, the scope of higher education should broaden not only as information disseminators but also as active skill producers, career-ready, and competency-driven for HRD.

2.3 Skill Mismatch in Higher Education and Market

Skills mismatch refers to the difference between the knowledge and skills students learn in higher education and those required by the labor market. It is a matter of increasing concern in the transition to a better and more inclusive labor

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market (Draissi et al., 2023). This mismatch can come in multiple shapes and sizes—whether a quantitative mismatch, a qualitative mismatch, or a geographic mismatch (Abelha et al., 2020). Mismatch of skills is a recognized barrier in Bangladesh that may lead to inefficient employment locations for fresh university graduates. Several research works and HRD-related surveys have revealed that higher education curricula in Bangladesh have frequently lacked the relevance to match real-world practices (Allen et al., 2013). This is despite the increasing number of university graduates who emerge each year, with the difficulty of finding skilled human resources reportedly mainly concentrated in ICT, finance, manufacturing, and service sectors. From an HRD perspective, the discrepancy serves to reduce productivity in the workplace, limit innovation in the workforce, and promote underemployment, job dissatisfaction, and wasted human capital (Bennett, 2002).

Root causes of this gap in Bangladesh are a lack of labor market information, employer participation in curriculum development, career guidance, and internship or on-the-job training opportunities (Hossain and Arefin, 2025). Additionally, the absence of structured skill programs integrated into degree program curricula hinders efforts to mitigate these issues. Addressing this gap necessitates a systemic model that encompasses universities, employers, policymakers, and HRD practitioners (Chisty et al., 2024). This can range from updating curricula to meet the newest industry needs, promoting the cooperation between universities and industry, developing skills-based training modules, and having students learn on-the-job via apprenticeships or co-op programs.

3. Objective of Research

The purpose of this study is to examine the core factors contributing to the skills gap among Bangladeshi graduates, focusing on the misalignment between higher education outcomes and industry expectations. Using an HRD perspective, it specifically explores how theory-dominated curricula, limited applied learning opportunities, and weak academia–industry collaboration shape graduate employability and workplace readiness.

4. Methodology

This research uses a qualitative approach to investigate skills gaps among Bangladeshi graduates from an HRD point of view. A qualitative design can be considered more appropriate, as this design enables a rich exploration of people’s perceptions and experiences and can offer valuable insights into the complex reality of higher education and employability. Instead of generalizing statistically, this research aims to provide the rich, contextual, and nuanced data that can help uncover the reasons, meanings, and institutional forces behind the observed skill mismatches in the context of Bangladesh.

In-depth interviews (IDI) were the main data collection method employed in this research. On the other hand, in-depth interviews enable a careful, flexible, and in-depth investigation of informants' perspectives and therefore provide adequate

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instruments for further questioning, such as those related to the development of skills, institutional cultures, and HR expectations. Notably, this study used open-ended, deep conversations, as this allows respondents the freedom to express themselves without being confined by predefined answer categories, fostering authenticity and depth in the data collected.

A purposive sampling technique was used to guarantee the presence of those who are implicated in the development of skills, talent scouting, feelings following the experiences related to graduate recruitment, training, performance, and the format or delivery context of higher education. The two primary participant groups were chosen:

Cluster 1: The sample group includes 46 HR professionals from different sectors in Bangladesh. The respondents were chosen among those who have been involved in hiring, training, or managing young graduates currently. These professionals held mid-to-senior-level HR roles such as HR Manager, Talent Acquisition Specialist, Training & Development Lead, HR Business Partner, and Head of HR. Participants were chosen based on three main criteria: (1) a minimum of five years' professional experience in either HR management or higher education; (2) active involvement in hiring, training, or curriculum design; and (3) willingness to provide reflective insights into graduate preparedness. Their insights provided critical data on the expectations, frustrations, and strategies related to graduate employability.

Cluster 2: The sample cluster recruited 6 academicians of the top-ranking public and private Bangladeshi universities as part of the study. These faculty members were from the undergraduate curriculum, career services, and skill development faculties. They were department chairpersons, professors, and members from academic councils or quality assurance cells. Their responses helped frame how universities perceive their responsibility to prepare graduates for the labor market and how they perceive and react to the emerging industry trends.

Purposive sampling was employed to ensure that participants possessed direct, relevant experience with graduate employability issues in Bangladesh. HR professionals were selected because of their first-hand role in assessing graduate skills during recruitment and managing workplace performance. Academicians were included as they directly influence curriculum design, pedagogy, and institutional strategies.

The interviews were conducted over a period of three months, utilizing a combination of in-person and virtual (Zoom/Google Meet) platforms, depending on the participants' availability and location. Each interview lasted approximately 45 to 90 minutes. The data collected through the interviews were analyzed using thematic analysis, a flexible and widely used method in qualitative research that allows the identification of patterns and meanings across the dataset.

This study adopted a qualitative research design, employing inductive thematic analysis as outlined by Braun and Clarke (Braun and Clarke, 2006). This approach was chosen for its flexibility in identifying patterned meaning across

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narratives while preserving the depth of participants' lived experiences. The method enabled a systematic yet interpretive exploration of stakeholder perspectives, ensuring rigor through iterative coding and theme development. Thematic analysis was considered particularly appropriate for this study, as it enabled the researcher to interpret the complex realities of skill gaps from multiple stakeholder perspectives, offering a rich and context-sensitive understanding of how higher education intersects with employability in Bangladesh. The analysis process began with a thorough familiarization with the data. All interviews, whether conducted in person or virtually, were audio recorded with the participants' consent and subsequently transcribed verbatim. The transcripts were then reviewed multiple times by the primary researcher to ensure accuracy and to begin identifying recurrent ideas and expressions. Notes and memos were created alongside this process to record early impressions and observations. Then, an open coding process was conducted, during which meaningful parts of the data were coded with brief phrases or words that encapsulated the core of the data. This inductive coding process guaranteed that the codes were derived from the data rather than from preconceived ideas. The verbatim transcripts were read by the authors, and passages related to the perception of graduate readiness, hiring difficulties, relevant curriculum, industry trends, and institutional obligations were coded in a systematic manner. The coding process was interactive, with concurrent comparison and modification to ensure clarity, consistency, and relevance. We initially coded our data by each participant cluster to retain both analytical power, in contrast to the number of quotes being lost, and different stakeholder voices. This enabled the researcher to investigate alignment and misalignment between academia and industry. Codes from the two groups were combined and refined to create more general categories and potential themes. The following codes were grouped into tentative themes that were constructed in order to make sense of the principal aspects of the skill gap issue.

These initial codes were then refined and tested against the data. This comprised examining each theme for coherence. For example, the data contained within the theme had to make sense and be meaningful, and distinct. Similar or overlapping themes were combined or refined, and where appropriate, sub-themes were generated to capture more specific patterns under the overarching theme of curriculum-practice misfit. These codes were compared to each other between the participant clusters (HR professionals vs. academicians) to maintain a clear identity of stakeholder voices. Overlapping codes were collapsed into wider categories through refining iterations, which eventually developed to form themes such as curriculum–practice mismatch, lack of workplace readiness, and institutional weaknesses in academia–industry cooperation. To ensure internal consistency and differentiation, themes were compared with the raw data for validation of interpretations. Peer debriefing among the investigators and checking up with transcript data improved credibility. Finally, themes were synthesized and discussed in the context of the research questions and the HRD lens. This synthesis employed an organic map of the causes of the skills gap for

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Bangladeshi graduates to illustrate the structure of constraints from a pedagogical and organizational perspective. A number of thematic stories were created to report the findings, complemented by the use of quotes from participants that maintained their voice and reinforced the findings in lived reality.

5. Findings & Analysis

Analysis of 52 in-depth interviews identified several themes commonly associated with the skills gap among Bangladeshi graduates. These themes also echo concerns of HR professionals and scholars that graduates are not ready to be in the workforce. Five core themes emerged:

5.1 Lack of Soft Skills and Communication Competence

An overwhelming majority (91%) of HR professionals report soft skills gaps, with communication, teamwork, and the ability to make presentations the most in-demand skills lacking among job candidates. Though scholastic and technical competence among the applicants was mostly deemed acceptable, a deficit of soft skills was seen as a deterrent to workplace effectiveness and future career advancement (Table 1).

Table 1: Detailed Analysis of Key Employability Skill Gaps Identified by HR Professionals

Skill	Perceived Gap Level	Gap Level Category	In-Depth Explanation
Communication Skills	65%	High	This was the most frequently cited skill gap. Respondents reported that many candidates lacked the ability to express ideas clearly, both in verbal and written communication. Common issues included poor sentence structure, limited vocabulary, weak business writing, poor email etiquette, and an inability to articulate thoughts confidently in professional settings.
Teamwork & Collaboration	70%	High	Employers observed that candidates often failed to function effectively within team settings. Challenges included difficulty in accepting feedback, lack of a cooperative mindset, resistance to group problem-solving, and inability to work across diverse teams. These deficiencies were seen as critical in roles requiring cross-functional collaboration.
Presentation Skills	85%	High	A significant number of HR professionals noted that candidates lacked the skills to organize and deliver impactful presentations. Weaknesses included monotone delivery, minimal audience engagement, poor use of visual aids, and nervousness under scrutiny. These limitations hinder candidates' ability to lead meetings or communicate ideas to stakeholders.

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Skill	Perceived Gap Level	Gap Level Category	In-Depth Explanation
Technical Job Knowledge	87%	Very High	Despite possessing basic technical knowledge, a large majority of HR professionals reported that candidates struggled significantly with applying this knowledge effectively in practical work situations. Challenges included difficulty in problem-solving, adapting to new technologies, and using industry-specific tools confidently. This gap indicates that while foundational understanding exists, the ability to translate theory into practice remains a major concern.
Academic Performance	22%	Low	Academic qualifications were generally satisfactory. HR professionals agreed that most candidates met basic educational standards. However, high academic scores did not correlate with professional readiness, as many lacked practical skills, critical thinking, and the ability to adapt to dynamic work environments.

Source: Author, Data Analysis

Note: Skill gaps reported by HR professionals were categorized based on frequency: Very High (above 85%) indicates critical gaps identified by the majority; High (50–85%) reflects significant concerns affecting employability; Less than 50% suggests moderate gaps not seen as widespread; and Low (below 30%) represents minor concerns where most candidates were found to be adequately skilled.

The research results reveal persistent deficiencies in fundamental employability skills, particularly in soft skills such as communication and teamwork, among numerous job applicants. These social skills are critical for successful teamwork and business interaction, yet underdeveloped, stunting job performance.

One of the respondents mentioned -

> "*Many graduates can write long reports, but when it comes to communicating an idea in a meeting or dealing with a customer, they freeze. That's a big concern for us*."— C1_Respondent-12- HR Manager, ICT Sector, Dhaka

Here, academicians also acknowledged this gap, attributing it to overemphasis on rote learning and lack of classroom interaction. One of the academicians mentioned-

> "*Our students rarely get a chance to express themselves in class. We test memory, not articulation or confidence*."— C2_Respondent-06- Professor, Public University, Dhaka

Presentation skills were also identified as a significant weakness of many, suggesting that the candidates tend to have difficulty structuring and delivering compelling stories, which can hinder their ability to lead and motivate in their chosen work environment.

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The technical knowledge of the candidates is relatively poor; however, a major problem arises from the gap between theory and practice. Real-world problem-solving and proficiency with industry tools are challenging for many candidates, suggesting a gap between academic prep and the actual job.

Even when learning performance is fine, it does not always result in readiness for work. This gap underscores the call for learning institutions to be aligned with actual work skills, as it points to curricular gaps leaving candidates unprepared for the changing workplace.

5.2 Skill-Job Mismatch and Irrelevant Curriculum

The skills gap is a major challenge faced by organizations in growing economies today because of the need to align what is taught in educational institutions with what is needed by industries. This behavior, also known as the skill-job mismatch, is closely associated with the outdated and sometimes irrelevant curriculum. This theme is critically elaborated upon constructively across this section through microanalysis of its components, causes, and consequences, constructing actionable pathways for alignment. Mismatch between the content of university curricula and the needs of the labor market was a major concern of HR professionals (79%). Participants noted that graduates do not possess the technical and digital skills needed for low-level jobs.

One of the respondents mentioned that

> "We hire engineers who don't know how to use Excel or write a professional email. That tells you how disconnected the system is." — C1_Respondent-05- Head of HR, RMG- Related Manufacturing, Chattogram

In Bangladesh, for example, many university graduates find it tough to get a job that matches their education. On the other hand, employers encounter difficulties in finding employees who have the skills to work at lower levels, especially in key sectors such as ICT, the financial services sector, marketing, and service provision.

Table 2: Key Areas of Skill-Job Mismatch

Mismatch Area	Description	Impact on Employment
Curriculum Irrelevance	Syllabi do not reflect current industry tools, practices, or knowledge trends.	Graduates lack job-ready competencies, leading to low employability.
Lack of Practical Training	Insufficient internships, case-based learning, or industry exposure.	Inability to perform on-the-job tasks efficiently.
Poor Industry-Academia Linkage	Weak collaboration between universities and the private sector.	Delayed curriculum updates and poor demand-supply alignment.

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Mismatch Area	Description	Impact on Employment
Inadequate Skill Mapping	No alignment between national skill frameworks and university programs.	Mismatched qualifications and skill shortages in key sectors.
Limited Soft Skills Integration	Communication, leadership, and teamwork are not embedded in curriculum.	Graduates face difficulties in interviews and team-based settings.

Source: Author, Data Analysis

Table 2 highlights the weak alignment between higher education curricula and industry needs. Rather than restating the raw details, the key insight is that universities remain heavily theory-oriented, often teaching outdated content and irrelevant case studies. This disconnect not only undermines the development of practical skills but also forces employers to retrain new hires or bypass them altogether. The findings further show that the lack of meaningful internships, fieldwork, and industry projects deprives students of opportunities to apply knowledge in authentic contexts. While institutions may nominally include such elements, they are often tokenistic, leaving graduates without the confidence or problem-solving capacity required in dynamic fields. Minimal engagement between academia and employers compounds this gap. Where partnerships exist, they tend to be ceremonial, with little impact on curriculum design. The result is a fragmented system where universities produce graduates trained in outdated methods, while industries demand competencies in digital transformation, sustainability, and emerging technologies.

These gaps, which have been identified, cannot be perceived in isolation but are rooted within the social, economic, and cultural as well as educational set-up of Bangladesh. From a broader socio-economic perspective, the speed of urbanization and growth in higher education institutions has greatly accelerated the number of graduates, but not their quality or fit with the labor market. Unis tend to focus on growth in numbers rather than reform of how they teach, and end up with a workforce that is adequate in quantity but not of sufficient quality. Culturally, education in Bangladesh has been historically formed by exam-focused traditions that value rote learning and memorization. This method discourages critical thinking, creativity, and independent learning, which are the qualities that modern industrial employers want.

In the educational setting, underfunding, outdated curriculums, and faculty development are systemic weaknesses. Industry involvement is infrequent, patchy, and when it does occur, it may not lead to significant curriculum innovation. Furthermore, national skill development policies and higher education institutions often work in silos, producing a fragmentation between policy wishes, e.g., digital literacy, renewable energy, AI, and what universities actually offer.

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5.3 Deficiency in Problem-Solving and Critical Thinking

A key finding of this study is the general lack of problem-solving ability and critical thinking of Bangladeshi graduates. This constraint was vehemently expressed by 91% of the HR professionals (Cluster 1), who pointed out that they frequently encounter problems with graduates being unable to deal with new situations, tackle complexity, or take autonomous actions. For them, this bridge is directly affecting their efficiency at work, particularly in disciplines that are more vibrant and creativity-based, such as ICT, marketing, and development.

Similarly, the academic experts (Cluster 2) also came to a consensus that, despite heavy reliance on theoretical bases, the Bangladeshi higher education system does not sufficiently develop the required analytical thinking for a modern economy driven by knowledge.

Identifying the context of a problem, considering alternative solutions, and justifying one's judgments are all essential components of problem-solving. Closely related is critical thinking, which involves challenging assumptions, synthesizing different pieces of information, and thinking logically under conditions of uncertainty. However, HR professionals and academics noted a lack of intellectual curiosity, a lack of decision-making confidence, and a difficulty in synthesizing information across multiple disciplines in Bangladeshi graduates.

This lack is also connected with traditions of the academy. The academicians of cluster 2 strongly agreed that the existing university examination system is more towards rote-based learning and memory-based examination. They encourage students to repeat back what the text says instead of showing comprehension or creativity. Moreover, the majority of classrooms still adopt target-oriented instruction. The learning is largely passive, and there is little room to engage in collaborative problem-solving, debates, or interdisciplinary exploration, all of which are crucial to the development of critical skills. This shortage does have real-world implications, according to 91% HR professionals. Those disparities are particularly pronounced for recent graduates, who often struggle to adjust to workplace practices that reward innovation, agility, and autonomy—even in industries such as start-ups, services, and tech-based fields. They are dependent on their managers for direction, don't take risks, and are reluctant to act without direct instructions. This hinders them from soldiering meaningful strategic intent and dealing with role complexity, especially under time pressure and ambiguous business conditions.

> "*They wait for instructions. When something unusual happens, they panic or escalate without even trying to think*."
>
> — C1_Respondent-37- Talent Acquisition Lead, Bank, Dhaka

Additionally, respondents from both clusters concurred that soft skills, such as thinking critically, are infrequently integrated into curricula or measured during course transmission. There's very little metacognition, reflection, or well-considered feedback-setting to help students learn and get better at how they think, learn, comprehend, and solve problems. Graduates can, therefore, 'ace'

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their exams but be underprepared in other ways for the real world, for innovation, and for being resilient with decision-making.

To fill this important void, HR practitioners and educators urged a change in pedagogy and testing. A compelling argument was made for project-based learning, cross-curricular learning, and inquiry-based teaching in which learners construct meaning by interacting with materials. Competency-based assessment that incorporates rubrics for inquiry, analysis, and application should be the goal of universities. Faculty development specific to moving from didactic to facilitative teaching roles is necessary for faculty to become enthusiastic users.

5.4 Lack of Professional Etiquette and Workplace Readiness

Another significant finding of this research is the evident lack of professional etiquette and workplace readiness among Bangladeshi graduates. Almost 82% of HR professionals (Cluster 1) expressed concern that graduates, despite having technical knowledge or academic credentials, lack the foundational understanding of professional behavior necessary for workplace integration. All six academicians (Cluster 2) also acknowledged that universities often overlook these aspects of student development. In a professional context, etiquette comprises a set of well-established norms that are adhered to by the members of an organization to which one belongs, and the organization expects them to be. The expectations pertain to general conduct and behavior, regardless of individual differences. The concept of being 'ready for the workplace' encompasses managing one's time, handling simple office correspondence, adapting to office culture, and demonstrating professional behavior within an organizational context.

Table 3: Key Gaps in Professional Etiquette and Workplace Readiness

Gap Area	Description	Impact Noted by HR Professionals	Consequences
Punctuality and Attendance	Graduates often lack discipline in maintaining regular attendance or timing.	Disrupts workflow and reflects poor reliability.	Seen as unreliable; risk of disciplinary action or job loss.
Email and Communication	Use of informal or inappropriate language in emails and verbal exchanges.	Damages professional image and creates confusion.	Limits promotion opportunities and reduces client-facing roles.
Appearance and Grooming	Lack of understanding about dress code and professional appearance.	Perceived as unprofessional during client or management interactions.	Negative impressions hinder acceptance and credibility.

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Gap Area	Description	Impact Noted by HR Professionals	Consequences
Meeting Etiquette	Poor attention span, interrupting others, and lack of preparation.	Seen as disengaged or disrespectful in team settings.	Exclusion from key discussions and leadership roles.
Office Culture Adaptability	Inability to align with organizational norms and work ethics.	Slows integration and team cohesion.	Results in isolation, lower job satisfaction, and attrition.

Source: Author, Data Analysis

Table 3 highlights consistent concerns from both HR professionals and academicians about graduates' deficiencies in workplace etiquette and preparedness. Beyond the raw data, these findings point to deeper structural and cultural issues. For instance, challenges with punctuality and meeting conduct are not only matters of individual discipline but also reflect inadequate professional socialization within higher education. Similarly, communication failures, particularly in business writing and formal interactions, signal the absence of structured training in applied communication skills. Issues of dress, self-presentation, and cultural fit further suggest that universities rarely emphasize the non-technical dimensions of employability, which employers nonetheless regard as crucial for integration and advancement. Taken together, these insights underscore that the problem is not limited to technical knowledge gaps but extends to professional behavior and workplace readiness, highlighting the urgent need for holistic employability training in higher education.

5.5 Limited Industry-Academia Collaboration

Industry-Academia linkage in Bangladesh was recognized as a major contributor to the increasing skill gap in the Bangladeshi graduates by 87% of HR personnel (Cluster 1) and all six academicians (Cluster 2).

HR respondents emphasized that universities rarely consult industry experts when designing curricula, resulting in graduates who lack applied skills, workplace awareness, and sector-specific competence. In regard to one of the respondents from cluster-1, mentioned

> "*Many freshers think a degree is enough. They're not humble enough to learn or grow*."— C1_Respondent-42- HR Manager, Telecom Sector

Academics recognized that they have insufficient interaction with employers and that partnerships are often tokenistic or hit-and-miss and do not have any significant impact on the 'real world' that students enter.

One of the respondents from cluster-2 mentioned –

> "*Internships are often tokenistic. Companies don't engage, and universities don't follow up. Students gain very little*."— C2_Respondent-3-MBA Coordinator, Private University, Dhaka

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Both clusters agreed that this gap weakens the relevance of education and hampers graduate readiness in today's competitive job market.

From HR Professionals' Perspective:

i. Graduates are not equipped with industry-required technical and soft skills for the job profiles.

ii. Companies need to invest more in onboarding, training, and oversight.

iii. It takes new hires more time to adjust to actual world expectations and processes.

iv. Diminished cooperation reduces the potential for talent pipelines.

v. Academic credentials as leading indicators of performance have lost their effectiveness in employers' eyes.

From Academicians' Perspective:

i. Curricula have not been revised in the same time due to a lack of recent industry feedback.

ii. There is inadequate faculty development because teachers are not getting any exposure to innovations.

iii. Exposure to internships or live projects is a casualty.

iv. Industry relevance is required to make research outputs relevant.

v. Colleges have a hard time proving their programs are worth the employment.

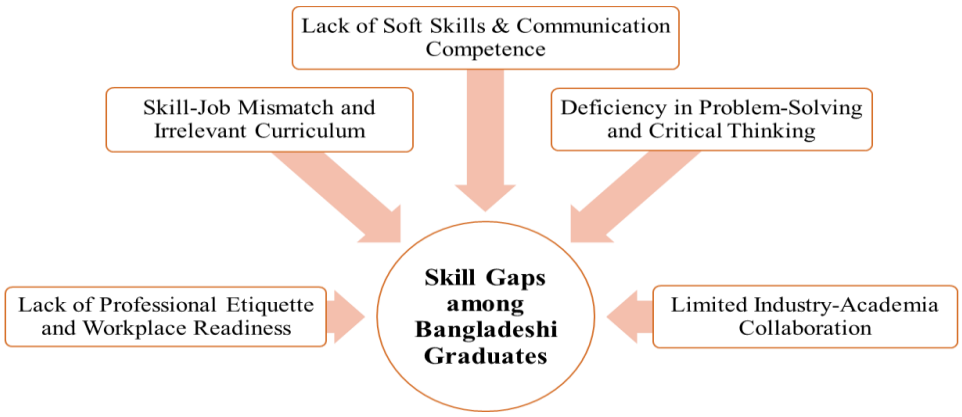

Figure 1: Thematic Model: Exploring the Skill Gaps among Bangladeshi Graduates

6. Discussion

This research aimed to investigate emerging divides between the higher education results and the expectations of industry in Bangladesh, and most specifically, graduate employability. Based on inputs from 46 HR professionals

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(Cluster 1) and 6 academicians (Cluster 2), the study critically analyzes the issues of skills-job gap, poor problem-solving and critical thinking, poor work culture, and low levels of workplace readiness. The implications of the results extend from the organizational and national levels to the context of global development, particularly in relation to Sustainable Development Goals (SDGs) affecting the education sector, such as SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).

An obvious issue emerging from the interview data analysis that a gap between academic content and industry requirements. Both groups of stakeholders also underscored that HE in Bangladesh is too much theory-oriented and less on applied learning, interdisciplinary approach, and employability-driven pedagogy.

Consequently, students do not possess the capacity to transfer knowledge to action, adapt to changing job demands, or ever function adequately in professional settings. This disparity is exacerbated by obsolete educational procedures, theory-laden sets of course materials, and scant students' exposure to industry-shaped learning situations. With universities anchored to tests that reinforce the memorization of formulas and techniques, students are prepared for jobs that instead require creativity, complex problem solving, communication, and digital literacy, none of which are well developed at traditional universities.

This study also shows that with a lack of problem-solving and critical thinking nature. More than 90% of HR officers said that graduates are 'not fully fit' to deal with problems at work on their own. They have trouble making decisions, struggle to think in shades of grey, and don't like ambiguity pretty much the skills we need in a 21st-century knowledge economy. Educators recognized this as one outcome of non-participatory classroom environments, in which students are seldom involved in critical discussions, in problem-based work, or in project-based assessment. The results suggest that there can be no progress without the development of pedagogical innovations and active learning methods in higher education if we want to stop delivering technically trained but intellectually undeveloped graduates.

Here, from these skills gaps, it is visible that the lack of professional etiquette and workplace readiness is another situation of concern. According to HR professionals, even academically strong youth encounter it difficult to display basics of professional behavior. Very little of this is addressed in school settings, where it is all about mastering subject matter.

Consequently, new grads struggle with team collaboration, representing their company, or becoming client-facing. Their lack of professional polish can slow the hiring process and dampen the faith in the employer about their sustainable future.

Moreover, poor interaction between industry and academia appeared as a major structural problem. Virtually all agreed that, without regular interaction, curriculum reviews, and joint ventures between universities and employers, graduates would continue to disappoint. HR heads, they said, are rarely even sought for advice on course content. Academics, for their part, concede that

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partnerships, when they exist, tend to be largely ornamental. This is a major deficiency that leaves students vastly underexposed to real-world problems, inventions, and solutions. Without industry input, academic institutions run the risk of producing educated yet unemployable graduates, and they begin to lose relevance to the national workforce.

Beyond the institutional shortcomings, the persistence of graduate skill gaps also reflects broader socio-economic and cultural dynamics within Bangladesh. The rapid massification of higher education has increased graduate numbers without proportional investment in quality, faculty training, or curriculum modernization. Simultaneously, cultural traditions of hierarchical teacher–student relationships and exam-centric pedagogy discourage questioning, debate, and experimentation, leaving students ill-prepared for professional contexts that demand adaptability and initiative. These structural and cultural influences, while less visible than curriculum content, play a decisive role in shaping graduate outcomes.

The findings also carry implications at the policy and national development level. Although Bangladesh has articulated national skills development strategies, these initiatives often operate in isolation from universities, resulting in fragmented pathways for students to acquire market-relevant skills. Without deliberate alignment between policy frameworks, industry demand, and higher education curricula, reforms remain piecemeal and ineffective. Addressing these challenges requires an ecosystem approach where government, employers, and academic institutions collaborate on long-term strategies for graduate employability. This systemic integration is essential not only for labor market competitiveness but also for advancing the country's commitments to SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).

7. Policy Recommendations

There are several practical policy implications resulting from these findings.

The first must be a national effort to sync academic curricula with industrial benchmarks. Universities should establish curriculum advisory boards, comprising corporate executives, startup founders, and alumni, to ensure the curriculum remains agile and innovative.

Second, it is essential to adopt competency-based education and active learning pedagogies. We need to move from a kind of lecture-based instruction to this experiential, project-based learning that teaches you the real stuff that actually applies and actually allows you to learn to think and be curious and really utilize your ability to learn.

Third, all undergraduate program curricula must include professional development and soft skills development. Universities should have core modules on communication, teamwork, professional grooming, ethics, and time management. These need to be taught through workshops, mentorship, peer feedback, and real-life practice.

Fourth, industry partnerships with academia need to be institutionalized or at least more intentional than just hoping they happen. Arranged internships,

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international guest lectures, industry-driven seminars, and real business projects may also help to close the exposure loop and prepare students for the work pressures of today's businesses.

Fifth, emphasis should be given to the training and retraining of faculty. It is recommended to inspire teachers to participate in corporate immersion programs, industry conferences, and material development with employers. This is to help them bring modern perspectives and real-world relevancy into classrooms.

Sixth, assessment systems need to be reformed so that they measure not only mastery of content but also application, teamwork, and independent thinking. Some of the enablers could be peer assessment, reflective portfolios, and case-based tests.

More broadly, the projects contribute directly to Bangladesh's pursuit of the Sustainable Development Goals. SDG 4 focuses on equitable and inclusive quality education and lifelong learning. This study emphasizes the need to rethink quality—not only in terms of enrollment or certification but also regarding the graduates themselves, who should be capable of adding value to both the economy and society. SDG 8, which demands decent work for all, requires, to a large extent, a highly educated and flexible workforce. Failure to address the graduate skills gap will continue to limit economic productivity and innovation.

8. Conclusion

This study explored the disconnect between higher education outcomes and industry expectations in Bangladesh, with a focus on graduate employability. Insights from HR professionals and academicians revealed significant skill gaps among graduates, including weak problem-solving, poor critical thinking, limited workplace readiness, and a lack of professional behavior. A recurring theme was the overemphasis on theoretical learning in universities, which limits students' ability to apply knowledge in practical settings and adapt to modern job demands. Both stakeholder groups highlighted that outdated curricula, passive teaching methods, and minimal industry exposure hinder students' readiness for the 21st-century workforce. Graduates often lack creativity, decision-making ability, digital literacy, and communication skills—key competencies in today's knowledge economy. Furthermore, the absence of structured collaboration between academia and industry was identified as a core structural weakness. Without active partnerships, curriculum alignment remains poor, and students remain disconnected from real-world challenges and solutions. These findings carry important implications for policy and practice, particularly in advancing Sustainable Development Goals (SDG 4 and SDG 8). The research underscores the urgent need for pedagogical reform, applied learning models, and institutional collaboration to bridge the education-to-employment gap and produce graduates equipped for meaningful, future-ready careers. By redesigning higher education curriculum to respond to changing labor market trends, incorporating instruction from industry practitioners, and emphasizing active learning, we can improve

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outcomes for graduates. It is more than an academic reform; it is a national development imperative. Looking ahead, the findings call for a more dynamic and forward-looking higher education system that embraces interdisciplinary teaching, embeds soft-skill development, and integrates technology-enhanced learning. Stronger academia-industry partnerships are vital, not only for curriculum alignment but also for creating work-based learning opportunities that prepare students for evolving labor markets. Policymakers should prioritize mechanisms for continuous curriculum review, incentivize faculty to adopt innovative pedagogies, and encourage employers to co-design training modules. At the institutional level, building a culture of applied learning and fostering entrepreneurial mindsets can equip graduates with adaptability and resilience. By situating reforms within the broader agenda of national competitiveness and sustainable development, Bangladesh can transform its higher education system into a driver of inclusive growth and global relevance.

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Divers Influencing the Adoption of Financial Technology (FinTech): Evidence from State-owned Commercial Banks in Bangladesh

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Abstract: *FinTech, or financial technology, is the use of digital tools and platforms to innovate, improve, and streamline financial services, increasing their accessibility, effectiveness, and security. The goal of the study is to understand the factors influencing the adoption of FinTech in Bangladesh's state-owned commercial banks. A 25-question survey was administered to 150 respondents, representing a wide range of FinTech service users, wherein multiple regression analysis was used. According to this study, the adoption of FinTech is influenced by internet connectivity, trust and security, performance expectancy, regulatory framework and social impact. The findings imply that the adoption of FinTech is strongly and favorably influenced by internet connectivity, trust and security, and social factors. Banks should increase public knowledge and understanding of financial services, implement comprehensive user financial literacy programs, and collaborate with regulatory bodies to establish a regulatory framework conducive to growth. By concentrating on Bangladesh's state-owned banks, which are essential to the nation's financial ecosystem, this study offers a novel viewpoint on FinTech adoption. It draws attention to the region's particular prospects and challenges, which are not covered enough in the current literature. Future studies should examine how FinTech adoption is influenced by technology providers, regulators, and private banks, as well as the effects of various national regulatory frameworks.*

Keywords: *FinTech Adoptation, Connectivity, Security, Expectancy, Regulation, Social Influence, State-owned Commercial Banks.*

1. Introduction

Mobile Financial Services (MFS) have become a revolutionary financial In the twenty-first century, financial technology (FinTech) has significantly transformed the global financial services sector (Burke, 2021). The financial services sector

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in Bangladesh has experienced a significant transformation, propelled by the emergence of FinTech. These digital platforms have eliminated geographical constraints, delivering financial services to formerly marginalized people through enhanced speed, efficiency, and accessibility (Datta, 2024; Sarker & Rahman, 2025). FinTech has evolved from mere technological innovation to an essential instrument for promoting financial inclusion by providing services that surpass conventional banking frameworks. It integrates technology and finance to develop creative solutions that significantly transform how individuals and organizations manage and access their financial data (Lee, 2024). FinTech aims to enhance the efficacy of financial services, hence improving client experiences by tackling several variables, including socioeconomic constraints and technological infrastructure, that affect its acceptance (Hatta & Alwi, 2021; Mohammeda & Hassan, 2024).

Financial Technology has become a principle point in Bangladesh's dynamic financial sector, particularly in the context of state-owned commercial banks in Bangladesh (Das, 2021; Hossain et al., 2021; Wu, 2023). According to (Basdekis et al., 2022; Wang et al., 2022), the nation's financial environment is significantly shaped by these six state-owned commercial banks, which act as catalysts for economic stability and advancement. These institutions' adoption of FinTech marks a revolutionary step forward for financial services innovation, accessibility, and efficiency. However, some significant studies such as (Aldás- Manzano et al., 2009; Lee, 2009; Li, 2013; Wang et al., 2022) contend that the growing acceptance of new technology and services in the financial sector cannot be entirely attributed to consumer pleasure. They demonstrate how customer behaviour, cognition, and personality traits, particularly, affect FinTech products' acceptance.

By providing access to innovative financial solutions, FinTech helps people who were previously unbanked or under-banked and helps communities achieve financial integration (Kim et al., 2018). FinTech promises cost-effectiveness, transparency, financial inclusivity, financial resilience, and many other advantages (Deng et al., 2019; Zetzsche et al., 2019). It is argued that agent banking services under FinTech, which include unbanked individuals in financial inclusion, will eventually create the chance for appropriate resource and finance mobilization while upholding safety and security (Hossain et al., 2021). If FinTech can increase customer satisfaction with better service and offers like reduced rates and fees and faster, more flexible, and transparent processes, it could exploit consumers' discontent with existing competitors to increase its market share (Maier, 2016).

The research objective is to examine the determinants of FinTech adoption in state-owned commercial banks in Bangladesh, with particular emphasis on connectivity, security concerns, performance expectations, regulatory variables, and societal influences. The study seeks to evaluate the impact of these elements on financial inclusion, customer satisfaction, and the modernization of banking services.

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This study distinguishes itself by examining the integration of FinTech in state-owned commercial banks in Bangladesh, a vital yet under-researched area of the financial system. It incorporates behavioral and psychological elements, including trust and client cognition, to enhance an understanding of the determinants of FinTech acceptability. The study underscores the significance of internet connectivity and infrastructure for successful implementation. Furthermore, it examines the regulatory and social influences shaping the emergence of FinTech, offering an extensive outlook on the sector's developments in Bangladesh.

2. Literature Review

Financing, cross-process, investment, and payment are the key elements of the developing FinTech business (Putritama, 2019). According to (Guild, 2017), it has been shown that peer-to-peer lending platforms and digital cash transfer services are two ways to innovate in finance research that examines FinTech adoption by means of behavioral intention to utilize the technology (Gao et al., 2011; Rodrigues et al., 2016; Safeena et al., 2011; Teo & Pok, 2003). Studies evaluating FinTech acceptance through real-world use are unusual, despite the prevalence of FinTech services.

2.1 Internet Connectivity

Researchers (Chen et al., 2023; Hjort & Tian, 2021; Qiang et al., 2009) examined whether increased internet connectivity benefits economic development by promoting innovation, boosting productivity, and expanding access to international markets. Researchers have also examined various aspects of internet quality, including coverage, speed, and reliability. To help close the digital divide, they have assessed the quality of internet access in rural areas (Deepika & Sundararajan, 2013; Houngbonon et al., 2022; Niranga et al., 2022).

Additionally, research focuses on internet connectivity technologies such as satellite internet, 5G, and fiber optics. A study published in 2020 (El-Rewini et al., 2020; Suryono et al., 2020) assessed advances in satellite internet, discussing its potential to provide high-speed connectivity to underserved and rural areas. Studies have identified barriers to connectivity, including cost, digital literacy, and limited infrastructure.

2.2 Trust and Security

Trust and security mean users feel confident in the dependability, privacy, and safety of FinTech services (Aldboush & Ferdous, 2023; Jafri et al., 2024). When users trust that platforms are dependable, secure, and private, they are more likely to use FinTech services regularly (Aljaradat & Shukla, 2025; Ridwan et al., 2024). Security concerns make it hard for people to adopt technology (Ogbanufe & Kim, 2018) and participate in e-commerce (Taherdoost, 2017; Tseng et al., 2017).

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2.3 Performance Expectancy

The Davis' Technology Acceptance Model (TAM), introduced by Davis (1989), suggests that perceived utility and ease of use influence users' attitudes and behavioural intentions toward technology use. According to Venkatesh & Zhang (2010), the Unified Theory of Acceptance and Use of Technology (UTAUT) paradigm incorporates several aspects, including performance expectancy. Research on e-commerce adoption found that perceived performance benefits strongly influenced customers' intentions to adopt online shopping. (Gefen & Straub, 2000). In healthcare, researchers discovered that performance expectancy was a strong predictor of doctors' adoption of technology. (Philippi et al., 2021; Venkatesh et al., 2003).

Performance expectancy greatly affected users' intentions to adopt mobile payment services (Lin et al., 2019). According to a study by Lu et al. (2017), for example, cultural factors influenced how consumers perceived performance benefits and their intent to use mobile payment services. Several studies examined moderating factors affecting the link between performance expectancy and technology adoption. Researcher (Shiau & Chau, 2016) showed that perceived self-efficacy mediated the relationship between behavioral intention to use mobile banking and performance expectancy.

2.4 Regulatory Environment

The regulatory environment comprises rules, guidelines, directives, and standards issued by governing bodies to ensure that FinTech enterprises operate fairly, safely, and ethically (Allen, 2024; Vijayagopal et al., 2024). Regulation significantly shapes the use of financial technology, influencing industry dynamics, trust, and daily operations. Efficient regulation is crucial to both innovation and the lasting success of financial services, particularly FinTech. These conditions also create opportunities to revise rules and start new businesses (Restoy, 2021; Treleaven, 2015; Tsai & Kuan-Jung, 2017).

2.5 Social Influence

Social influence is the impact of others on a person's decision to adopt a new system and on their view of the reference group's culture (Chuang et al., 2016; Davis, 1989; Kim et al., 2018; Venkatesh & Bala, 2008). It refers to how much a person believes that important individuals think they should adopt a new system. People close to someone can strongly influence changes in behavior (Chen, 2023; de Oliveira Santini et al., 2025; Miranda et al., 2024). We used social influence as a key variable to see if FinTech adoption by associated companies affects FinTech users' intentions.

Investigating FinTech adoption in Bangladesh's state-owned institutions is vital because it affects the financial sector, economy, and society. Identifying what drives adoption can help these banks overcome regulatory challenges, improve financial inclusion, and enhance services (Mahmud et al., 2022; Robin et al., 2025). Furthermore, adopting FinTech can strengthen competitiveness by promoting innovation and collaboration with entrepreneurs (Barua et al., 2025).

This study is unique in that it focuses on state-owned commercial banks in

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Bangladesh, a topic that has received little attention in the research on the adoption of Fintech. Although earlier research has generally assessed FinTech adoption, this study makes a distinctive contribution by examining the specific effects of internet connectivity, trust and security, performance expectancy, regulatory environment, and social influence on FinTech adoption in these essential institutions. By examining these variables, this study aims to provide insights to financial regulators, bank managers, and government officials on the most effective ways to boost FinTech service adoption and promote financial inclusion and economic growth in Bangladesh.

3. Research Hypothesis

The research hypotheses were formulated based on theoretical concepts and prior empirical evidence about the Adoption of Financial Technology (FinTech):

H1: The adoption of FinTech by six state-owned commercial banks in Bangladesh has been significantly affected by the internet connectivity.

H2: The adoption of FinTech by six state-owned commercial banks in Bangladesh has been significantly affected by trust and security.

H_3: The adoption of FinTech by six state-owned commercial banks in Bangladesh has been significantly affected by the performance expectancy.

H4: The adoption of FinTech by six state-owned commercial banks in Bangladesh has been significantly affected by the regulatory framework.

H5: The adoption of FinTech by six state-owned commercial banks in Bangladesh has been significantly affected by social influence.

4. Research Methodology

4.1 Sources of Data and Sample Size

Primary data were collected through a questionnaire survey of bank customers to ensure a complete understanding. The survey was targeted to investigate respondents' perceptions of FinTech and the determinants affecting its adoption. A standardized questionnaire was developed, including five-point Likert (Nemoto & Beglar, 2014; South et al., 2022) scales to assess attitudes toward critical variables such as connectivity, security, performance expectancy, regulatory factors, and social influence. The final sample comprised 150 respondents, representing clients from six state-owned commercial banks in Bangladesh.

4.2 Econometric Model and Variable Description

Econometrics, which focuses on empirically estimating economic relationships, relies heavily on models and data (Meyer & Shera, 2017; Nasr et al., 2000). To examine the connections between variables, multiple linear regression models are frequently employed. These models include diagnostics, model formulation, and estimation methods (Greene et al., 2019). Here, the Econometric Model as follows:

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$$FinAD_{i,t} = \beta_0 + \beta_1 X_{1i,t} + \beta_2 X_{2i,t} + \beta_3 X_{3i,t} + \beta_4 X_{4i,t} + \beta_5 X_{5i,t} + \varepsilon_{i,t} \quad \text{......}(i)$$

FinAD stands for FinTech Adoption. X1 is the Internet Connectivity; X2 stands for Trust and Security; X3 is the Performance Expectancy; X4 stands for Regulatory Environment; X5 represents Social Influence. Here, i denotes banks, t denotes time (year), and ε is the error term.

Table 1: Variables Measurement

Serial No.	Variable Name	Variables Definition	Sources
Dependent Variable			
1	FinTech Adoption	The process through which people or organizations start using financial technologies like online lending platforms, digital payment systems, and block chain-based services to handle their financial affairs is known as FinTech adoption.	(Mahmud et al., 2022; Wu, 2023)
Independent Variable			
2	Internet Connectivity	The capacity of devices to connect to the internet, including the different technologies and infrastructures that make this connection possible, is referred to as internet connectivity.	(Gozzi et al., 2024)
3	Trust and Security	Security and trust refer to users' faith in the dependability, confidentiality, and safety of systems, particularly in digital platforms, which guarantee the protection of their data and transactions.	(Jafri et al., 2024; Zhang et al., 2023)
4	Performance Expectancy	The extent to which a person thinks that utilizing a specific technology would improve their performance at work is known as performance expectancy.	(Camilleri, 2024; Sari et al., 2024)
5	Regulatory Environment	A regulatory environment is made up of the laws, rules, and policies set forth by governing authorities that affect how industries operate and guarantee ethical and compliant behaviour.	(James Jr, 2000; Martínez et al., 2023)
6	Social Influence	Social influence is the process through which other people's presence or actions alter a person's attitudes, beliefs, or behaviours; this frequently results in conformity or behavioural changes.	(Moussaïd et al., 2013)

4.3 Conceptual Framework

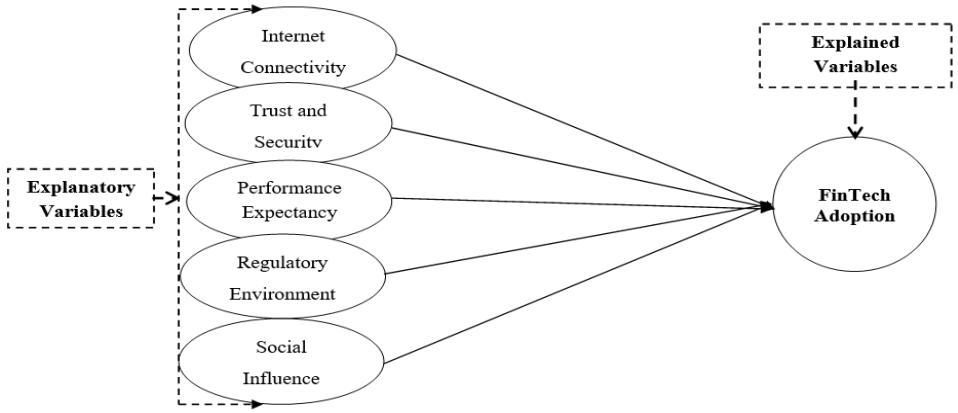

Figure 1: Conceptual Framework of the Study

5. Data Analysis

5.1 Descriptive Statistics

The descriptive statistics display the mean, standard deviation, minimum, maximum, skewness, and kurtosis. The biggest value is indicated by Maximum, and the lowest number is displayed by Minimum. The mean is calculated by dividing the total number of observations by the average value of all the observations. The standard deviation, skewness, and kurtosis values are used to assess the consistency of the data and determine the degree of risk.

Table 2: Descriptive Statistics

	Obs.	Min.	Max.	Mean	Std. Dev.	Skewness	Kurtosis
FinTech Adoption	150	1.00	5.00	2.270	1.609	0.3061	2.880
Internet Connectivity	150	1.00	5.00	3.591	.8056	-0.4762	2.917
Trust and Security	150	1.00	5.00	3.591	.8139	-1.0494	2.722
Performance Expectancy	150	1.00	5.00	3.898	.7245	0.5783	1.073
Regulatory Environment	150	1.00	5.00	3.591	.8084	0.7513	2.660
Social Influence	150	1.00	5.00	3.693	.7484	-1.0145	1.944

Notes: The table shows the mean, standard deviation, minimum, skewness, and kurtosis of the FinTech adoption, performance expectancy, internet connectivity, regulatory environment, trust and security, social influence with a total sample size of 150, questionnaire surveys were used to collect the primary data sources.

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The mean value of Performance Expectancy was at 3.8978, showing a positive response, and it also had the lowest standard deviation of 0.72450. By comparison, the mean for FinTech adoption was 2.27, with a standard deviation of 1.609. Turning to other factors, the mean values were as follows: internet connectivity at 3.59, trust and security at 3.59, regulatory environment at 3.5911, and social influence at 3.6933. Additionally, skewness and kurtosis values were within the standard range. Therefore, the data are normally distributed.

5.2 Reliability and Validity Test

Valid and reliable data collection is required for producing high-quality research findings (Perret et al., 2001). The accurate findings will be revealed if the data is accurate. It is necessary to test the validity and reliability of the instruments used in this study in order to assess their suitability for use (Cook & Beckman, 2006). To confirm the reliability of the questionnaire, Cronbach's alpha was employed. $\alpha < 0.50$ = Unacceptable, $0.50 \leq \alpha < 0.60$ = Poor, $0.60 \leq \alpha < 0.70$ = Acceptable, $0.70 \leq \alpha < 0.90$ = Good (High Reliability), and $\alpha \geq 0.90$ = Excellent (Very High Reliability) are the values indicated by Cronbach's alpha (Cronbach, 1951).

Table 3: Reliability Statistics

Cronbach's Alpha	N of items
.919	18

Cronbach's alpha for the 18 entries in this table is 0.919, which is higher than 0.90. This indicates that the data or indicators used for analysis in this study are of extremely high quality.

5.3 Sample Adequacy and Sphericity Test

The study has tested five hypotheses with different dimensions and variables. Determining whether a dataset is appropriate for the study is therefore necessary.

Table 4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.882
Bartlett's Test of Sphericity	Approx. Chi-Square	519.447
	Df.	18
	Sig	.000

The sample sufficiency index KMO by Kaiser-Meyer-Olkin is shown in the Table below. At 0.70 (70%), it is considered reliable. This index compares observed correlation coefficients with the partial correlation coefficients for all analysis variables, resulting in 0.882 (94.0%) (Yong & Pearce, 2013). The Bartlett test confirmed a substantial correlation between variables, with its sphericity test yielding 0.000.

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5.4 Correlations Analysis

Table 5: Correlations Analysis

	FinTech Adoption	Internet Connectivity	Trust and Security	Performance Expectancy	Regulatory Environment	Social Influence
FinTech Adoption	1					
Internet Connectivity	.284**	1				
Trust and Security	.158**	.651**	1			
Performance Expectancy	-.210**	.512**	.605**	1		
Regulatory Environment	-.266**	.556**	.617**	.640**	1	
Social Influence	.225**	.480**	.580**	.705**	.670**	1

*Statistically Significant *p<0.10, **p<0.05, *** p<0.01; t statistics are enclosed in parentheses.*

Notes: The table shows the results of Pearson's pairwise correlation coefficients between the examined variables. Total sample size was 150, questionnaire surveys were used to collect the primary data sources.

Internet Connectivity, Trust and Security, Performance Expectancy, Regulatory Environment, and Social Influence are the five factors associated with FinTech adoption shown in the table, along with their Pearson correlation coefficients. There are noteworthy correlations between FinTech Adoption and Internet Connectivity ($r = 0.284$, $p < 0.01$). There is also a significant association between FinTech Adoption and Trust and Security ($r = 0.158$, $p < 0.04$), as well as between FinTech Adoption and Social Influence ($r = 0.225$, $p < 0.01$). On the other hand, Performance Expectancy has a strong negative relationship with FinTech Adoption ($r = -.210$, $p < 0.02$), meaning that as Performance Expectancy increases, FinTech Adoption decreases. Similarly, Regulatory Environment also has a strong negative relationship with FinTech Adoption ($r = -.266$, $p < 0.01$), indicating that higher values in Regulatory Environment are associated with lower FinTech Adoption. All significant relationships have p-values below 0.05, emphasizing how crucial these variables are in determining FinTech adoption.

5.5 Regression Analysis:

Table 5: Regression Analysis

Variables/Particulars	Pooled OLS Model
Internet Connectivity	4.668** (.506)
Trust and Security	0.826** (.323)
Performance Expectancy	4.469 (.054)

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Variables/Particulars	Pooled OLS Model
Regulatory Environment	4.130 (.321)
Social Influence	4.653** (.157)
Constant	-.783** (-.194)
F-Stat	41.048*** (385.793)
R^2	0.586
Adjusted R^2	0.580
No. of Observations	150

*Statistically Significant *p<0.10, **p<0.05, *** p<0.01; t statistics are enclosed in parentheses.*

Notes: The table shows the results of the specific effects of internet connectivity, trust and security, performance expectancy, regulatory environment, and social influence on FinTech adoption in six state-owned commercial banks in Bangladesh where Pooled OLS Model (multiple regression) was applied to measure the impact.

The dependent variable (FinTech Adoption) and the independent variables: internet connectivity, trust and security, Performance expectancy, regulatory environment, and social influence have a strong correlation, as indicated by the R^2 value of 0.586 between the explanatory variables and FinTech Adoption. According to the R^2 value of 0.586, the model is suitable, and the data fit the model well. The fact that all of the independent factors significantly contribute to explaining the variation in FinTech adoption within Bangladesh's state-owned commercial banks is confirmed by the adjusted R^2 value of 0.580, which is extremely close to the R^2 value. To assess the correlation between FinTech adoption and the independent variables, the F-test was used. The F-test results show a significant relationship, as the p-value (0.000) is less than 0.05 and the F-value of 41.048 (with degrees of freedom 5) exceeds the critical value of 2.21. Thus, the alternative hypothesis is accepted, and the null hypothesis is rejected. These outcomes demonstrate that multiple independent factors jointly affect FinTech adoption.

The regression analysis reveals that internet connectivity, trust and security, and social influence are significant predictors of FinTech adoption in state-owned commercial banks in Bangladesh, as all corresponding p-values are below 0.05. Their coefficients are 0.506, 0.323, and 0.157, respectively, with a constant of -0.194. The regression model captures the positive association between these predictors and FinTech adoption: improvements in internet connectivity, trust and security, and social influence correspond to higher adoption rates. These results highlight the critical role of these factors in driving FinTech adoption in the banking sector.

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6. Findings and Discussion

Internet connectivity showed a positive and significant effect on the adoption of FinTech by six state-owned commercial banks in Bangladesh (β=.506, t=4.668, p=0.020). This outcome aligns with Ediagbonya & Tioluwani (2023), which demonstrates that internet availability considerably affects FinTech adaption. Trust and security also produced a positive and significant result on FinTech adoption (β=.323, t=0.826, p=0.030) among the six state-owned commercial banks in Bangladesh. This finding is corroborated by Jafri, (2024), indicating trust and security as positive drivers of adoption. Social influence has a substantial effect on FinTech adoption in six state-owned commercial banks in Bangladesh. Results show a positive and significant impact (β=.157, t=4.653, p=.048), consistent with findings by Hoque (2024).

The findings enhance theoretical understanding by demonstrating that internet connectivity, trust and security, and social influence are pivotal factors in FinTech adoption within state-owned commercial banks in Bangladesh, thereby reinforcing models that prioritize technological infrastructure, risk management, and socio-cultural elements in digital adoption. From a managerial standpoint, banks ought to highlight improving internet accessibility, fortifying security measures, and utilizing social influence via consumer engagement techniques to elevate adoption rates. These conclusions suggest that customer-centric technical and social solutions are more effective than depending exclusively on performance advantages or regulatory measures.

This research provides multiple theoretical contributions to the FinTech adoption literature. It enhances previous technological adoption frameworks (e.g., TAM and UTAUT) by incorporating internet connectivity, trust and security, and social impact as interconnected factors of adoption (Amnas, 2025; Budisusetyo, et al., 2025). This research situates these linkages within state-owned commercial banks, providing novel insights into the influence of institutional factors on digital transformation. It presents the notion of institutional-technical fit and illustrates how infrastructure and regulatory legitimacy jointly affect adoption behavior (Shaikh & Hasan, M., 2025). Social influence is redefined as a process that reduces risk and promotes normative acceptance in conservative banking contexts. The results indicate that customer-focused and socially integrated tactics encourage technology adoption more effectively than solely performance-driven incentives. The report redefines FinTech adoption as a multifaceted construct, highlighting infrastructure and socio-cultural factors rather than viewing it strictly as a technology issue (Hoque, 2025). It enhances theory by demonstrating how public institutions in emerging economies assimilate digital technologies within the constraints of their structural limitations. This research enhances the external validity of adoption models in emerging market environments. It elucidates the relationship between technological readiness, trust management, and social dynamics in the context of FinTech adoption in public financial institutions.

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7. Conclusion

Digital technology is changing financial services to meet new customer needs. Performance, laws, social impact, internet access, security, and trust influence its use. Bangladesh's state banks must adapt to compete. But government rules, technology problems, costs, and other barriers slow FinTech growth. Businesses, authorities, and the government should work together to overcome these challenges. Partnerships between state banks and FinTech firms are also key to success. Building on these points, the main takeaway is that, according to both UTAUT and TAM, performance expectancy, internet access, trust and security, and the regulatory environment most strongly drive FinTech adoption in Bangladesh's state-owned banks. These findings provide a framework for understanding FinTech adoption in developing countries.

Findings of our study have direct managerial implications. Regulators and financial institutions should use these insights to drive FinTech adoption. Banks should improve their digital infrastructure and partner with telecom providers to expand internet access. Institutions should raise customer awareness and financial literacy to build trust. Regulators must ensure balanced regulation to foster innovation and protect consumers. State banks should train staff and invest in cyber-security as priority actions.

A key finding is that collaboration among banks, regulators, and FinTech firms is essential for a stable and innovative FinTech environment, as balanced regulations developed with all stakeholders i.e. directors, managerial bodies, employees, govt. authorities and who have the interest in this field promote both innovation and consumer protection. Turning to future research, this study focuses on state-owned banks, limiting insights into the broader financial sector. Future research should include private banks, regulators, legislators, and FinTech providers for a fuller understanding. A broader focus will reveal how different players and regulations shape FinTech adoption. Including FinTech suppliers' perspectives will deepen understanding of opportunities and challenges.

In summary, taking a broader approach will reveal what best drives FinTech use and will provide a clear path for strengthening it across Bangladesh's financial sector. The lessons from these studies will help integrate FinTech into the national financial system and ensure cooperation among public, private, and regulatory roles for growth and inclusion.

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Appendix

Demographics Profile Analysis

According to the responses of different customers of six State-owned commercial banks in Bangladesh to the questions in the data collection tool, the following finding is obtained:

	Particulars	Frequency	Percentage (%)
Gender	Male	78	52
	Female	72	42
Age	18-25	99	66
	26-30	38	25.3
	31-35	5	3.3
	35 above	8	5.3
Occupation	Students	75	50
	Employed	38	25.3
	Self Employed	18	12
	Others	19	12.7
Income Level	Less than 25,000	100	66.7
	25,000-39,000	22	14.7
	40,000-59,000	22	14.7
	60,000 above	6	4
Respondents Distribution	Sonali Bank PLC	29	19.3
	Rupali Bank PLC	26	17.3
	Janata Bank PLC	25	16.7
	Agrani Bank PLC	22	14.7
	BASIC Bank PLC	24	16
	Bangladesh Development Bank PLC	24	16

Source: Drawn from Authors' questionnaire

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Impact of Financial and Nonfinancial Factors on Job Satisfaction of Primary School Teachers in Bangladesh: A Mediating Role of Job Stress

JUJBR

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Abstract: *The study's goal is to find out how financial and nonfinancial factors affect Bangladeshi primary school teachers' job satisfaction and stress levels. Additionally, it determines how job stress influences job happiness. To attain the objectives of the study, a quantitative approach was used. The study used SPSS and PLS-SEM to examine how different factors affect primary school teachers' perceptions of job satisfaction. Various statistical analyses, including descriptive analysis, discriminant validity, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), confirmatory factor analysis, F-square test, regression analysis, and hypothesis testing, were performed. The study found that the financial factors and the non-financial factors have significant impacts on job satisfaction and job stress. It also found that job stress has significantly impacts on job satisfaction. Job stress has a mediating effect (partial Mediation) on the relationship among financial factor, non-financial factors and job satisfaction. Improving the standard of education and the general well-being of the teaching staff may be greatly impacted by the job stress and happiness of primary school teachers in Bangladesh. On the other hand, a more engaged and productive teaching staff can improve students' outcomes and the school climate when work satisfaction is high.*

Keywords: *Job satisfaction; Job Stress; primary school teacher; Bangladesh.*

1. Introduction

1.1 Background of the study

In any educational system, teaching is a dynamic and ever-changing job. The role of a teacher encompasses more than only imparting knowledge. A good education is built on the foundation of good teachers. By laying the human foundation for sustainable education, educators contribute to its advancement on a daily basis. Teachers are the ones who value each child's aptitude and motivation to learn

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(DPE, 2022). Teachers' work, performance, productivity, dedication, management, and relationships with their subordinates all suffer when they are very much unhappy in their work. Job satisfaction is crucial at educational institutions. Teachers' and educational institutions' everyday lives are significantly impacted by job satisfaction (Dey et al., 2013). Primary school, sometimes referred to as elementary school or grade school, is the initial phase of formal education, usually for kids between the ages of five and eleven. It focuses on foundational skills like reading, writing, and arithmetic, as well as social and emotional development, preparing students for secondary education (MoPME, 2023).

Job satisfaction is the level of contentment that workers have with their jobs, encompassing cognitive, affective, and behavioral components of institutional behaviors. Job contentment is characterized by Locke et al., (1976) as an emotional and affective reaction to a job or particular aspects of the job. Spector (1997) opined- job contentment means the degree to which employees experience positive feelings (satisfiers) or negative feelings (dissatisfies) concerning their work. Positive or negative reactions to the activity overall or to specific elements of the activity in particular are ways that job satisfaction is conveyed. Numerous things might have an impact on job satisfaction, including working environment, skills, working style, and other pertinent factors (Sumanasena et al., 2020). It should be highlighted that both inner and extrinsic factors influence job happiness, with a particular emphasis on an employee's value system and the organizational culture that fosters it (Medhi, 2018). Additional intrinsic elements that affect job happiness include a person's age, gender, or even lifestyle, encompassing work experience, marital situation, and level of education. Extrinsic measures of job satisfaction are derived from a wide range of organizational operations, including possibilities for career advancement, coworkers, supervision, the particulars of the tasks performed, organizational culture, etc. (Arbia et al. 2023). It has been repeatedly demonstrated that certain forms of non-monetary motivation greatly satisfy employees, and it is the responsibility of management to comprehend employee requirements and aspirations in order to meet them.

1.2 Objective of the study

The basic goal of this study is to find out how financial and nonfinancial factors affect Bangladeshi primary school teachers' job satisfaction and stress levels. More specific objectives of this study are given below:

i. To determine the level of job satisfaction of primary school’s teachers in Bangladesh.
ii. To determine the level of job stress of primary school’s teachers in Bangladesh.
iii. To explore the impact of financial and non-financial factors on teachers’ job stress to job satisfaction.

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2. Literature Review

According to Herzberg (1959), the employment motives can be divided into two categories. The motivational motive is one, and the hygienic factor is the other. Neither the hygienic elements nor the motivational factors were exclusively intrinsic. Ability utilization, interpersonal supervision, communication satisfaction, morality, creativity, coworker relations, independence and autonomy, technical supervision, organizational stability and prospects, recognition, clarity of role and responsibility were among the motivating factors that had a significant impact on employees'. The hygiene factors comprised of salary, justice, growth opportunity, policy fairness, time management, job security, had no bearing on job satisfaction. However, there was a considerable co-variance between the hygiene and motivational elements, suggesting that employees cannot be motivated by ignoring the hygiene factors (Sanjeev & Surya, 2016). Therefore, it is advised that components classified as Extrinsic Factors be acknowledged as having a direct influence on workers' job satisfaction (Yusoff, et al, 2013). A number of theories and methods have assessed various aspects of job satisfaction. One of these theories that concentrated on job satisfaction both generally and in detail is the Herzberg Motivation-Hygiene Theory (1959), which addressed the significance of job satisfaction in businesses by taking into account all relevant internal and external elements (Mehrad, 2015). When considered separately, both hygiene and motivation factors had a positive and significant impact on job engagement, with the exception of financial rewards and recognition. However, hygiene factors lost all of their impact on job engagement when both factors were examined together as independent variables using a stepwise regression analysis. This suggests that even in a changed society, Herzberg's two-factor theory (1959) is still valid today (Chu & Kuo, 2015).

Maslow's (1943) thesis is focused solely on human needs and is oversimplified. Each worker has unique needs. Many people are simply happy with their stable jobs and basic physiological needs. It helps managers understand the behavior of their employees. Additionally, it helps managers provide suitable financial and non-financial incentives to their employees. All things considered, this helps the company become more efficient, profitable, and productive (Trivedi & Mehta, 2019). One long-term advantage of employee motivation is high productivity. An organization's business and revenue growth are strengthened by motivated employees, who are a significant asset. If the correct individual with the right talents is assigned to the position, motivation work; otherwise, time and resources may be wasted and job discontent may result (Kaur, 2013). Abraham Maslow's (1943) hierarchy of requirements has seven (7) levels of demands, ranging from the most basic level of physiological needs to the greatest level of aesthetic needs. Aesthetic demands give people in different societal communities the chance to enjoy beautiful surroundings in their houses, including painted backgrounds, artwork, and flowers. In order to realize human needs at the community level, appropriate use of Abraham Maslow's (1943) hierarchy of needs is necessary, with an emphasis on fundamental wants that must be satisfied

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before considering other human needs in society (Aruma & Hanachor, 2017). Highly satisfied employees work harder and positively affect the effectiveness and efficiency of their businesses. Workers that are content at work work harder and be more committed to the business (Thiagaraj & Thangaswamy, 2017).

Begum & Ullah (2025) demonstrated that female teachers at government colleges are content with the following factors: freedom in the workplace, an environment free from harassment, flexible work schedules that accommodate family and organization, and the resources and amenities provided by the ministry and authorities. However, there are also some significant areas of unhappiness in these sectors, such as inadequate promoting systems, gender prejudice in these fields, and the need to enhance basic amenities like housing, transportation, health care, and insurance. Gan et al. (2025) opined that the observed discrepancy was mediated by clear gender disparities in work performance, with female teachers reporting higher contextual performance and male teachers exhibiting higher task performance. Subsequent investigation revealed that marital status also matters, with a greater gender disparity observed among instructors who are single. Yeasmin et al. (2025) explained that 1.85% of teachers have high and 7.40% of teachers have average level of knowledge about gender disparity and also 90.75 percentages teachers lie in the low-level knowledge regarding gender disparity out of 54 teachers from primary schools of Kolkata who took part in the survey. Sulaimi & Jantan (2024) portrayed that they have a stronger propensity to devote their time and energy to their teaching duties, which leads to increased commitment and professionalism retention. Latif (2024) mentioned that male and female school teachers in terms of progress, working conditions, supervision, and social requirements have great disparity
Akhtar et al. (2022) uncovered that female teachers are unhappy with how the primary school schedule is set up, while most teachers said that their head teacher did not care about gender equality in their school. Kumar et al. (2023) Flexibility in working conditions has a significant impact on job satisfaction. Roy & Das (2020) examined that there is some indication that female educators have a more positive attitude than their male counterparts. The results of this investigation are consistent with those of other researchers. Iqbal & Anwar (2008) investigated that 62% are not fully satisfied with their low pay scales. Other reasons for discontent were parents' and students' lack of cooperation, employment uncertainty, their poor performance, their colleagues' lack of cooperation, and the profession's lack of recognition.

2.1 Financial Factors on Job Stress and Job Satisfaction

Guoba et al. (2022) portrays that there is a statistically significant correlation between teachers' contentment with their pay and their satisfaction with contingent rewards and promotion possibilities. Islam et al. (2020) Perceived happiness with supervision and promotion prospects is correlated with teachers' contentment with contingent compensation. Additionally, statistically significant correlations were discovered between instructors' satisfaction with the nature of

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their work, contingent rewards, and communication and supervision. Widyayu et al. (2023) found that job satisfaction and intention to depart were not significantly impacted by individual characteristics. Workload, monetary remuneration (strong), and job satisfaction (medium) are the factors that have the biggest impact on the intention to leave (medium). Kumar & Hossain (2017) Workplace stress and monetary compensation have a fairly direct impact on job satisfaction. Salary is a type of periodical payment from authorities to employees that are specified by the authorities' contract. But salary is contrasted with a piece of wage, in where wages are paid individually by one unit, an hour or each job without periodical basis (Barman and Bhattacharyya, 2017). It means upward movement of employees from their current positions to another position within an organization which is higher or better in hierarchy, responsibility and pay. Promotion holds an inbuilt value that acts as a motivation and upgrades the power and status of employees in the society or within the organization (Islam, et al., 2018). Bonus can affect its employees and firms negatively or positively. Sometimes, it may provide false expectations. Employees look forward to getting bonus payments. If an organization doesn't have the capability to do so, the employees may be stressed and the organization can fail to achieve its targets. Normally bonus incentivizes employees' morale and the employees feel appreciated and rewarded (Agnihotri and Mir, 2019).

Uncommon or uncustomary fringe benefits are not elementary benefits and they are provided for the employees to gear job satisfaction and can be able to fit the company profile. Uncommon fringe benefits also result in increasing loyalty of the employees and side by side decreasing their turnover rates (Alam et al., 2005). Thapa (2020) opened that employee job satisfaction was significantly impacted by both monetary and non-monetary compensation. The results also indicate that their present level of education, job title, and department all have a substantial impact on their level of job satisfaction. Similarly, employees' job satisfaction was more positively impacted by financial remuneration than by non-financial compensation.

2.2 Non-Financial Factors on Job Stress and Job Satisfaction

Hamzah & Matkhairuddin (2023) opined that job satisfaction and non-financial rewards have significant relationship, highlighting the strong influence that non-financial benefits have on people's job satisfaction. This emphasizes the notion that satisfied workers raise satisfaction levels with their non-cash benefits. Kumar (2016) Employees are satisfied when they receive formal praise, when managers understand their behaviors, when they receive appropriate recognition, continuous feedback, informal praise, and regular recognition from their managers. Postolov & Postolov (2021) explained that 76% of men and 74% of women responded favorably to the question on how training affected physicians' non-financial motivation for work happiness. Physicians who are surveyed had a high acceptance rate for the importance of balancing their personal and professional lives and working conditions, as well as non-financial incentive on work satisfaction and it can be freely concluded that their fulfillment imply great

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satisfaction from the work of the researched sample. Training programs are planned or sketched out to make employees better professionals. Employees who are provided training are tried to better work behavior and job performance. To do this, it is designed various constructive activities, worthwhile instructions and effective or efficacious tools (Sumanasena et al., 2020). Tausif (2012) demonstrated that promotion, work enrichment, and task autonomy are examples of non-monetary benefits that have significant and positive correlations with job satisfaction. Promotion has strong correlates with employee job satisfaction, but task autonomy has a weaker correlation. Age and job satisfaction are significantly correlated. Additionally, age is associated with work autonomy, job enrichment, and promotion.

2.3 Herzberg's Two-Factor Theory

According to Herzberg's Two-Factor Theory (1959), there are two factors, one is- motivational factors and the other is- hygiene factors. Hygiene factors are maintenance elements, extrinsic factors, or job content aspects; motivational factors are intrinsic factors (Mehrad, 2015).

Maintenance or hygiene factors: These elements are recognized as employment dissatisfiers and are linked to employees' unpleasant emotions. They don't help employees become more productive. Consequently, they provide no motivation. When these components are present in adequate quantities, job unhappiness is avoided, but employees are not motivated by them (Sanjeev & Surya, 2016). The elements of this factor are-Salary; Job Security; Personal life; Working Conditions; Status; Inter-personal relations with Supervisor; Inter-personal relations with Peers; Inter-personal relations with Subordinates; Company Policy and Administration; Technical Supervision.

Motivation Factors: There are motivational elements in the workplace. They are relevant to the substance of the job. They happen when the work is being done. These components are necessary to sustain high levels of job satisfaction and performance (Sanjeev & Surya, 2016). The elements of this factor are- Work itself; The Possibilities of personal growth; Responsibility; Recognition; Advancement and Achievement (Yusoff, et al, 2013). The foundation of Herzberg's two-factor theory (1959) was the idea that job happiness results from the presence of one set of job attributes, while job discontent results from the absence of a totally separate set of job attributes (hygiene). Herzberg's Two-Factor Theory (1959) has been extensively applied in a wide range of motivational studies spanning generations and industries (Chu & Kuo, 2015).

By differentiating between Hygiene Factors (preventing dissatisfaction, such as good pay, working conditions, and fair policies) and Motivators (creating satisfaction and motivation, such as recognition, responsibility, student growth, and autonomy), Herzberg's Two-Factor Theory (1959) assists primary teachers and directs schools to improve both environments to increase teacher satisfaction and performance, not just by resolving complaints but also by enhancing the teaching experience itself.

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2.4 Maslow's Hierarchy of Needs

American psychologist Abraham Harold Maslow (1943) lived from 1908 to 1970. His most well-known contribution to the categorizing of human upward demands was a theory he developed. Maslow's (1943) need hierarchy theory of motivation is the name of this well-known theory. According to Maslow (1943), there are five categories of human needs that are mobilized in a hierarchical manner. This indicates that the demands are met in a specific order, starting with the lowest and working up to the highest (Thiagaraj & Thangaswamy, 2017). According to Maslow's (1943) theory of the needs hierarchy, people would strive to satisfy their safety and security needs more when their physiological requirements are met. It implies that the satisfaction of the requirements should be associated rather than the sense of the desire (Aruma & Hanachor, 2017). Based on human needs, Maslow (1943) created a five-stage hypothesis, these are- Biological and Physiological needs; Safety needs; Social needs (love and belonging); Esteem needs; and Self-actualization needs (Kaur, 2013).

Maslow's (1943) theory aids primary school teachers by offering a framework for comprehending that students cannot learn effectively (self-actualization) until their basic needs-food, safety, belonging, and esteem-are satisfied. By tackling hunger with school meals, bullying with clear rules, loneliness with group projects, low self-worth with praise, and encouraging creativity to help students fulfill their potential, teachers may create supportive, all-encompassing classrooms that eventually increase motivation and academic success. A theory called Maslow's (1943) hierarchy of requirements describes the various levels of human wants and how they connect to growth and motivation. This hierarchy aids in our understanding of how students' basic needs must be satisfied before they can participate completely in the learning process. In the context of education, Maslow's (1943) theory of the hierarchy of needs is highly relevant for the primary school teachers. It offers insightful information on comprehending and meeting students' needs, which can have a significant impact on their engagement, motivation, and general well-being in the classroom.

3. Research Gap

Numerous studies have examined and determined that both monetary and non-monetary aspects significantly contribute to ensuring job satisfaction. Their findings indicate that satisfaction and stress related to teaching are statistically significant, particularly in elementary schools. From the reviewing of the literature it is evident that most of the reviewed literatures on job satisfaction related variables are advancement, and supervision (Sahito & Vaisanen 2017), pay scale (Rahman & Al-Amin, 2014), working conditions, rewards and accommodation, incentives (Sumanasena et al., 2020), distribution of courses, fringe benefits (Alam et al., 2005), relations with supervisors, authority, co-workers, independence and moral value (Kumar, 2016), and infrastructure, classroom facility, cooperation of parents etc. (Kalita & Boruah, 2020). Besides there are a lot of stress and satisfaction factors or elements that are inter related

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with each other. But less attention has been given to some job satisfaction and job stress factors in primary schools such as- Salary Structure, Promotion Policy, Festival Bonus, Fringe Benefits, Recognition, Job Autonomy, Job Security, Training and Development Program, Working environment, Coworkers relationship, and supervisor role. And no mediating effect is shown. To address this gap, the researcher has tried their best how these factors affect job satisfaction and make job stress in the teachers of primary schools in Jhenaidah district of Bangladesh.

4. Conceptual Framework and Hypothesis of the Study

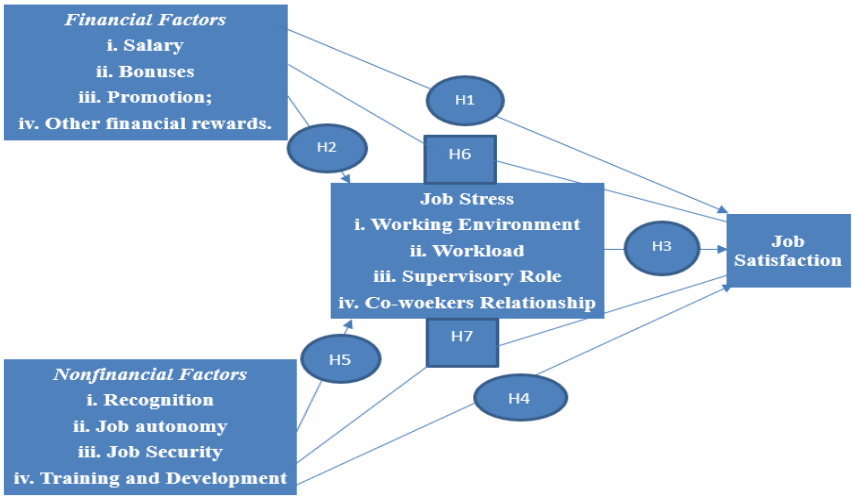

Figure 1: Conceptual Model of the study

Hypothesis of the study

H_1: Financial Factors have significant impacts on Job Satisfaction.
H_2: Financial Factors have significant impacts on Job Stress.
H_3: Job Stress significantly impacts on Job Satisfaction.
H_4: Non-financial Factors have significant impacts on Job Satisfaction.
H_5: Non-financial Factors have significant impacts on Job Stress.
H_6: Job stress mediates the relationship between Financial Factors and Job Satisfaction.
H_7: Job stress mediates the relationship between Non-financial Factors and Job Satisfaction.

5. Research Methodology

The study area covers six upazalas of Jhenaidah district of Bangladesh. According to District Education Primary Office, Jhenaidah (29 February, 2025), the total number of teachers is 4821. As the total population is 4821, that means it is a finite population so the researcher uses Yamane's (1967:886) simplified formula to determine sample size.

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Sample size, $n = \frac{N}{1+N(e)^2}$ (e= 0.05)

$$n = \frac{4821}{1 + 4821(0.05)^2}$$

$$n = 370$$

Here, n= sample size (for known population= 4821 and e = the desired level of precision, set to 0.05 or 5 %.). The minimum sample is 370 but betterment of the study 400 respondents has been allocated through six upazila of Jhenaidah district are as follows- Jhenaidah Sadar 108, Maheshpur 70, Kaliganj 66, Kotchandpur34, Shailkupa 64, and Harinakunda 58 respondents

This study collects primary data from the respondents of the selected primary schools using a well-structured questionnaire that is administered for the 400 primary school teachers. . Secondary sources of information include books, magazines, newspapers, internet, and various research-based publications. Purposive sampling is used to conduct this study because of the researchers' actual knowledge that targeted respondents contribute significantly to this study by providing accurate and correct opinions and information that could not be obtained from other types of respondents. The questionnaire consists of some demographic variables, two independent variables (financial factor and non-financial factor) one moderating variable (job stress) and dependent variable is job satisfaction. The corresponding items of the questionnaire are measured by 5-point Likert scale, in where range is 1 (highly dissatisfied) to 5 (highly satisfied). To attain the objectives of the study, a quantitative approach has been used. The study makes use of Partial Least Squares Structural Equation Modelling (PLS-SEM) and the Statistical Package for Social Science (SPSS) to test the structural relationships among variables influencing respondents' evaluations of the job satisfaction (Hair et al., 2021). Various statistical analyses, including descriptive analysis, discriminant validity, Cronbach's alpha, average variance extracted (AVE), composite reliability (CR), confirmatory factor analysis, F-square test, regression analysis, and hypothesis testing were performed.

6. Data Findings and Analysis

Table 1: Demographic Profiles of the Respondents

Factors	Sub group	Frequency	Percent
Gender	Male	166	41.5
	Female	234	58.5
Age	21 to 30 Years	19	4.8
	31 to 40 Years	169	42.3
	41 to 50 Years	130	32.5
	51 to 60 Years	82	20.5
Educational	SSC Pass	9	2.3

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Factors	Sub group	Frequency	Percent
qualification	HSC Pas	70	17.5
	Graduate	145	36.3
	Post Graduate	176	44.0
	SSC Pass	9	2.3
Marital Status	Married	389	97.3
	Unmarried	11	2.8
Job experience	1 to 5 Years	48	12.0
	6 to 10 Years	54	13.5
	11 to 15 Years	108	27.0
	16 to 20 Years	37	9.3
	21 to 25 Years	42	10.5
	26 years to above	111	27.8

Source: Researcher's Computation by SPSS 26.

Table 1 presents the frequencies and percentages of information regarding the gender, Age, Educational qualification, Marital Status and Job experience of employees who participated on questionnaire survey. It showed that among 400 respondents, 234 female and 166 male and with percentage of 41,.50% and 58.50% respectively. Age of the respondents total 42.3 (42.3%) are 31 to 40 years of their age limit. Besides, 20.5% were the age of 51 years to above and only 4.8% were 21 to 30 Years. The largest number of respondents, comprising 176 respondents had completed their post-graduation, representing 44% of the total. Conversely, 36.3% respondents had a graduate degree. 97.3% were married and only 2.8% were unmarried among 400 respondents. The experience of the respondents 27.8% were aged 26 years and above. 10.5% were 21 to 25 years, 9.3% were16 to 20 years, 27% were11 to 15 years, 13.5% were 6 to 10 years, and the last one was 12% were1 to 5 years.

Table 2: Level of job stress of respondents

Construct	Frequency	Percent	Valid Percent
Highly Disagree	35	8.8	8.8
Disagree	206	51.5	51.5
Neutral	76	19.0	19.0
Agree	77	19.3	19.3
Highly Agree	6	1.5	1.5
Total	400	100.0	100.0

Source: Researcher's Computation by SPSS 26.

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Table 2 portrays that level of job stress of respondents 206 (51.5%) was disagreed, 77 (19.3%) respondents was agreed, 76 (19%) respondents was neutral, 35 (8.8%) was highly disagreed and last is 6 respondents which means 1.5% was highly agreed among 400 respondents.

Table 3: Job satisfaction level of the respondents

Construct	Frequency	Percent	Valid Percent
Highly Dissatisfied	32	8.0	8.0
Dissatisfied	207	51.8	51.8
Neutral	70	17.5	17.5
Satisfied	85	21.3	21.3
Highly Satisfied	6	1.5	1.5
Total	400	100.0	100.0

Source: Researcher's Computation ***by SPSS 26.***

Table 3 reveals that level of job satisfaction of respondents 207 (51.8%) was dissatisfied, 85 (21.3%) respondents was satisfied, 70 (17.5%) respondents was neutral, 32 (8%) was highly dissatisfied and last is 6 respondents that means 1.5% was highly satisfied. among the 400 respondents.

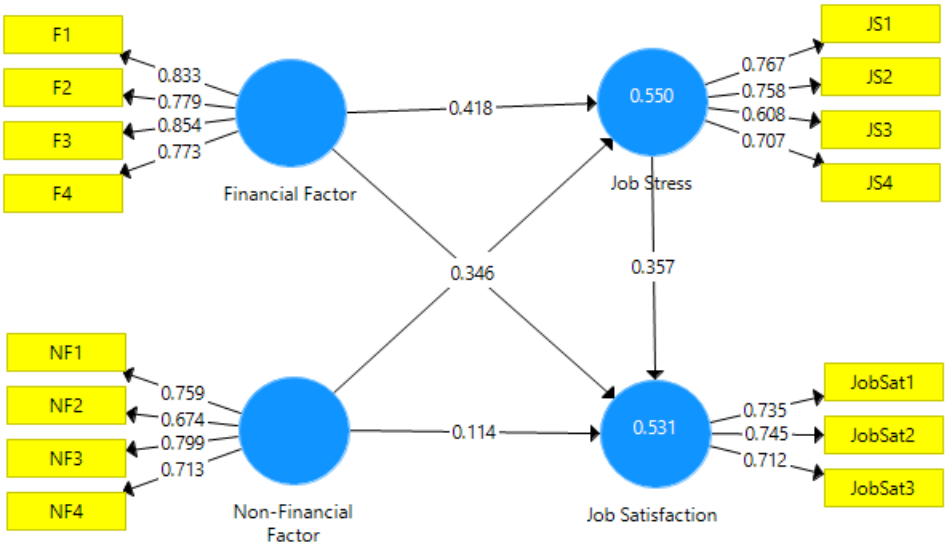

Figure 2: Measurement model of the study

The variables that have been measured are identified and explained using the measurement model. The factor loading evaluates the relationship between the factor and the item; a factor loading greater than 0.30 typically indicates a

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moderate relationship between the factor and the item (Edrisi et al., 2020). In this study, the loading values of all these factors are good for further research.

Table 4: R Square Value

Construct	R Square	R Square Adjusted	Result	Threshold
Job Satisfaction	0.531	0.528	Moderate	0.75= Strong, 0.50= Moderate, 0.25= Weak
Job Stress	0.550	0.547	Moderate	

Greater explanatory power is shown by higher R^2values, which range from 0 to 1(Hair et al., 2021). The table presents the results of the R^2 value. As shown in Table 4, the model demonstrates good predictive relevance for all the endogenous variables. The study reported an R^2 value of 0.531 for the latent variable Job Satisfaction and 0.550 Job Stress, signifying that the independent variable accounts for 53.10% and 55.00% of the variance in the dependent variable.

Table 5: f Square value

Construct	Job Satisfaction	Job Stress	Comment	Threshold (effect)
Financial Factor	0.121	0.225	Medium effect	0.02-0.15=Small, 0.15-0.35= Medium, 0.35= Large effect.
Job Stress	0.122		Large effect	
Non-Financial Factor	0.013	0.205	Medium effect	

The effect size of the predictor constructs is assessed using Cohen's f^2 (Cohen. 1988). All the values in this study indicate medium to large effects.

Table 6: Construct Reliability and Validity

Factor	Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Financial Factor	F1	.888	0.884	0.657
	F2	.890		
	F3	.887		
	F4	.889		
Job Satisfaction	JobSat1	.893	0.775	0.534
	JobSat2	.893		
	JobSat3	.894		
	JS1	.890	0.804	0.508

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Factor	Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Job Stress	JS2	.891		
	JS3	.897		
	JS4	.894		
Non-Financial Factor	NF1	.891	0.827	0.545
	NF2	.895		
	NF3	.892		
	NF4	.892		

The study's clever PLS technique (structural equation modeling) has been used to calculate the capacity instrument's internal consistency. It is acceptable for the average variance extracted (AVE) value to be 0.50 or above. (Hair et al.,2021). The composite reliability values are 0.884, 0.775, 0.804 and 0.826, while the AVE values are 0.657, 0.534, 0.508 and 0.545.

Fornell-Larcker Criterion

This is among the most popular techniques. Each construct's square root and the correlations between it and other constructs are compared. If the square root of AVE is larger than the inter-construct correlations, discriminant validity is verified (Fornell & Larcker, 1981). The correlation with other constructs shown in Table 12 below is not as significant in this study as the square root of AVE (in bold and italics) for a construct. Therefore, the Fornell-Larcker Criterion establishes discriminant validity.

Table 7: Discriminant Validity Fornell-Larcker Criterion

	Financial Factor	Job Satisfaction	Job Stress	Non-Financial Factor
Financial Factor	***0.811***			
Job Satisfaction	0.660	***0.731***		
Job Stress	0.676	0.666	***0.713***	
Non-Financial Factor	0.648	0.576	0.669	***0.738***

(Fornell & Larcker, 1981) mentions that weak correlations between the pertinent measures and measurements of other constructs suggest discriminant validity, which is the extent to which measures do not reflect other constructs. The AVE exhibits discriminant validity when its square root is greater than its correlations with all other variables. Hair et al. (2021) noted that to make sure that a reflective construct has the strongest correlations with its own indicators, discriminant validity can be used in PLS route modeling. However, it can be assumed that the discriminant validity of two conceptual ideas has been proven if the Fornell-Larcker Criterion score is less than or equal to 0.90.

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Table 8: Collinearity Statistics (VIF)

Construct	Items	VIF
Financial Factor	F1	2.064
	F2	1.613
	F3	2.157
	F4	1.519
Job Stress	JS1	1.384
	JS2	1.321
	JS3	1.173
	JS4	1.317
Job Satisfaction	JobSat1	1.131
	JobSat2	1.212
	JobSat3	1.172
Non-Financial Factor	NF1	1.398
	NF2	1.357
	NF3	1.619
	NF4	1.230

In the initial step of the structural equation model, lateral collinearity was assessed using the collinearity statistic known as the "variance inflation factor" (VIF). Although vertical collinearity was satisfied, lateral collinearity (predictor-criterion collinearity) can occasionally lead to misleading results. When two variables that are thought to be causally related measure the same construct, this kind of collinearity takes place. Collinearity was determined by evaluating the VIF values; each indicator's VIF value should be less than 5 (Hair et al., 2011). Table 8 presents the VIF values, indicating that collinearity is not present. The VIF measures this type of collinearity.

Table 9: Goodness of Model Fit

Construct	Saturated Model	Estimated Model	Threshold
SRMR	0.089	0.089	SRMR <0.10 = good fit
d_ULS	0.950	0.950	
d_G	0.313	0.313	
Chi-Square	704.295	704.295	
NFI	0.705	0.705	NFI: 0.60-0.90=Acceptable

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The inference statistics of the bootstrap-based test can be used to analyze the precise overall model fit metrics, According to Hair et al. (2017), SRMR values up to 0.10 can be acceptable. The SRMR value is 0.089. It fits good most of the time. The Bentler–Bonett normed fit index (NFI) was also adopted to determine the model's approximate fit (Henseler et al., 2016). Singh (2009) noted that the value of an acceptable NFI should range from 0.6 to 0.9. The NFI derived for this study was 0.705, and was within the given threshold. This model's NFI value is 0.705. It fits good most of the time.

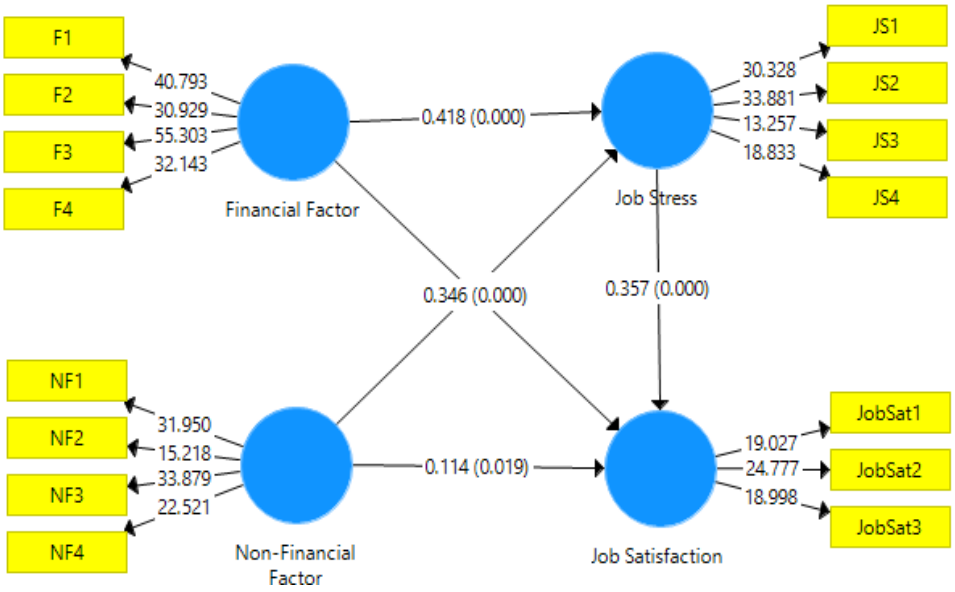

Figure 3: Structural Model of the study

Table 10: Result of Hypothesis Testing

Contract	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/ STDEV|)	P Values	Decision
H_1: Financial Factor -> Job Satisfaction	0.346	0.346	0.053	6.551	0.000	Accepted
H_2: Financial Factor -> Job Stress	0.418	0.419	0.042	9.908	0.000	Accepted
H_3: Job Stress -> Job Satisfaction	0.357	0.355	0.049	7.235	0.000	Accepted
H_4: Non-Financial Factor -> Job Satisfaction	0.114	0.117	0.048	2.347	0.019	Accepted
H_5: Non-Financial Factor -> Job Stress	0.399	0.400	0.042	9.484	0.000	Accepted

Note: At 5% level of significance

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Figure 3 and Table 10 show the following hypotheses.

H1: Financial Factor has a significant impact on Job Satisfaction. This hypothesis is supported ($t = 6.551$, $p < 0.0001$), meaning that Financial Factor has a significant impact on Job Satisfaction.

H_2: Financial Factor has a significant impact on Job Stress. This hypothesis is supported ($t = 9.908$, $p < 0.0001$), meaning that Financial Factor have a significant impact on Job Stress.

H_3: Job Stress significantly impact on Job Satisfaction. This hypothesis is supported ($t = 7.235$, $p < 0.0001$), meaning that, Job Stress significantly impacts on Job Satisfaction.

H_4: Non-financial Factor has a significant impact on Job Satisfaction. This hypothesis is supported ($t = 2.347$, $p < 0.0001$), meaning that Non-financial Factor has a significant impact on Job Satisfaction.

H_5: Non-financial Factor has a significant impact on Job Stress. This hypothesis is supported ($t = 9.484$, $p < 0.0001$), meaning that Non-financial Factor has a significant impact on Job Stress.

Table 11: Mediation Analysis Job Stress to Job Satisfaction

Construct	Beta	Sample mean	S/D	t-statistics	P values	Decision
H_6: Financial Factor -> Job Stress-> Job Satisfaction	0.149	0.149	0.026	5.652	0.000	Partial Mediation
H_7: Non-Financial Factor -> Job Stress -> Job Satisfaction	0.142	0.142	0.024	5.991	0.000	Partial Mediation

Table 11 shows partial mediating effect of job stress with financial and non-financial factors and job satisfaction, where job stress has a mediating effect (partial Mediation) on the relationship between financial factor and job satisfaction ($\beta = 0.149$, $t = 5.652$, $P = 0.000$), where direct effect was ($\beta = 0.346$, $t = 6.551$, $P = 0.000$). Job stress has also a significant impact (Partial Mediation) on the association of non-financial factor and job satisfaction ($\beta = 0.142$, $t = 5.991$ $P = 0.000$), where direct effect was ($\beta = 0.114$, $t = 2.347$, $P = 0.019$), providing evidence supporting hypotheses H6 and H7.

7. Conclusion

In Bangladesh, primary school teachers' job happiness has a big influence on their output, the results of their students' education, and the standard of education as a whole. While job discontent can result in burnout, lower motivation, and ultimately a detrimental effect on student learning, high job satisfaction is associated with enhanced productivity, better teaching quality, and greater

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dedication to students. According to the study, primary school teachers would inevitably experience employment stress. The working environment, workload, relationships among coworkers, and managerial duties are the primary causes of workplace stress. Additionally, it was discovered that teachers are not entirely content with their positions; they have issues with their pay, bonuses, promotions, and other forms of assistance. Financial and non-financial factors significantly impact job stress and job satisfaction. Job stress negatively affects job satisfaction. To enhance job satisfaction among primary school teachers in Bangladesh, recommendations include improving compensation, providing flexible transfer policies for female teachers, addressing management harassment, ensuring fair teacher-student ratios, and promoting professional development opportunities. Additionally, factors like a supportive work environment, manageable workloads, and recognition for their contributions are crucial.

8. Managerial Implications for the Govt. Primary School Teachers

The findings from this study provide several actionable insights for measuring job stress and job satisfaction of govt. primary school teachers in Bangladesh. This research offers direction on how institutions can reduce their employees' job stress and to enhance their job satisfaction and to ensure better job performance. According to the current study, in order to lessen job stress and improve job satisfaction, primary school teachers in Bangladesh require both non-financial factors like recognition, job autonomy, job security, training, and development as well as financial factors like salary, bonuses, and promotion. Additionally, this study makes a contribution by providing an overview of the demographic's variables of primary school teachers. This study will support for the welfare of the teaching profession and help to sustain teachers' mental and psychological wellbeing. By addressing issues like pay, workload, promotion, recognition, autonomy, working conditions, and professional development, teachers can improve performance, lower turnover, foster better student outcomes, and increase overall school effectiveness. This is because contented teachers are more engaged, productive, and less likely to miss work due to stress.

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Green Human Resource Management: Examining the Relationship Between Green Training, Green Work Engagement, and Employee Retention

JUJBR

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Abstract: *This study investigates the impact of green training on employee retention, focusing on the mediating role of green work engagement. Grounded in Green Human Resource Management (GHRM), and drawing from social exchange theory and the ability–motivation–opportunity (AMO) framework. A quantitative survey was conducted among 237 Bangladeshi garment workers. Partial least squares structural equation modeling (PLS-SEM) was employed to evaluate the hypothesized relationships. The results indicate that green training has a significant positive effect on employee retention, both directly and indirectly through green work engagement. Specifically, green training enhances employees' engagement in environmentally responsible work, which subsequently improves retention. Besides, the mediation analysis in this study confirms that green work engagement partially mediates the relationship between green training and employee retention. These findings enhance the green human resource management literature by illustrating the dual influence of green training on retention via skill enhancement and psychological engagement. The study emphasizes the necessity of investing in comprehensive green training programs that encompass not only technical skills but also motivational elements. Integrating green training into the overall HRM strategy can improve the company's reputation and attract environmentally conscious workers, which will help the firm retain employees in the long term.*

Keywords: *Green human resource management; Green training; Employee retention; Green work engagement; Sustainability*

1. Introduction

1.1 Background of the Study

The investigation into the impact of green training on employee retention, facilitated by green work engagement, has become a significant area of research owing to the rising global focus on environmental sustainability and organizational competitiveness (Al-Hajri, 2020; Huo et al., 2022). The integration of green human resource management (GHRM) practices has transitioned from traditional HRM approaches to include environmentally

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sustainable recruitment, training, performance assessment, and compensation over the past decades (Alshaabani et al., 2021). The number of relevant present studies in practice is minimal, despite knowing that turnover intentions in millennials, highlighting the research gap regarding retention mechanisms in green HRM contexts (Islam et al., 2022). This study enquires about the underlying mechanisms of green training (GT) for promoting retention and uncovers the mediating channel of green work engagement (GWE) (Haque et al., 2024). Although GHRM has been identified with positive employee outcomes, existing studies rarely explain how engagement translates GT into retention (Judeh & Khader, 2023).

In this study, GHRM is defined as the integration of environmental objectives into HR policies and practices, GT refers to HRM practices that focus on improving employees' understanding of the environment and their capacity to address environmental issues (Alshaabani et al., 2021), GWE is defined as the intensity of employees' energy, dedication, and absorption in environmentally focused tasks (Aboramadan, 2020), and employee retention (ER) refers to the strategies geared toward maintaining a stable and committed workforce in an organization (Al-Hajri, 2020). The model suggests that GT fosters GWE that acts as a mediating bridge in the relationship between GHRM practices and GT, informed by social exchange theory and the job demands–resources model (Aboramadan, 2020; Haque et al., 2024).

The study examines the effect of GT on ER, specifically highlighting the mediation function of GWE. The empirical context is the Bangladeshi garment industry, selected due to its labor-intensive nature, high turnover rates, and increasing environmental compliance requirements. The study empirically supports these associations, utilizing data from 237 respondents through Partial Least Squares Structural Equation Modeling (PLS-SEM).

1.2 Objectives of the Study

The primary objective of this study is to examine the effect of GT on employee retention, with particular emphasis on the mediating role of green work engagement. Specifically, the study seeks to:

i. examine the relationship between GT and ER.
ii. investigate the relationship between GWE and ER.
iii. analyze the mediating role of GWE in the relationship between GT and ER**.**

1.3 Contribution of the Study

This study advances both theoretical and practical knowledge. In practical terms, it guides organizations on how to improve knowledge retention by linking human behaviors to organizational training practices. Theoretically, it reinforces and extends SET, JD-R, and AMO frameworks within the green HRM domain, satisfying the concern of a clear theoretical contribution. The results provide managers with tangible proof that investing in GT simultaneously fulfills

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corporate sustainability goals while also increasing engagement and retention, leading to a more environmentally responsible and loyal workforce.

2. Literature Review

Environmental training is a valuable tool to retain staff by engaging with them more in the environmental work. Many factors impact the link, yet the most important is green work engagement. GT can significantly enhance employee engagement as they would know the skills and knowledge to participate in environmentally sustainable practices. This engagement is necessary, as it establishes the association between GT and the retention of employees (Dwumah et al., 2025; Tran, 2023). GT can promote high employee engagement in the mining industry, where achieving a level of organizational green culture and green work ethics is a prerequisite to sustaining such engagement benefits (Bahizire & Pea-Assounga, 2024).

The application of GT contributes to a firm's future sustainability performance by cultivating a workforce adept at addressing environmental demands. Recent studies suggest that firms offering novice training through managerial roles enhance employee satisfaction and cultivate essential skills for long-term success (Alhemimah et al., 2024; Bahizire & Pea-Assounga, 2024). GT in tourist and hospitality modules improves sustainable work behavior; it acts as a mediator between green organization learning to sustainable work behavior (Alhemimah et al., 2024). These arguments support the strategic relevance of GT but do not fully explain the psychological mechanism linking training to retention.

Employers must understand how vital the impact of green HRM practices on ER and GWE is as a bridge between green HRM and environmental performance. According to K (2024), engaged employees have a higher tendency to stay when they are given a chance to do meaningful work. Evidence from the hospitality field indicates that the enabling role of GWE is confirmed by green inclusive leadership, which increases green work engagement, subsequently promoting organizational citizenship behavior and retention (Abdou et al., 2023**).** The agriculture sector reveals that green HRM and leadership are critical to green work engagement, emphasizing the immediate need to introduce organizational culture and practices that advocate for environmental sustainability (Tran, 2023). Thus, the synergetic relationship between green HRM, employee engagement, and sustainable techniques (Moran et al., 2025) becomes an indispensable approach for organizations to excel in an environmentally aware market.

GWE represents the relationship between green HRM practices and environmental performance. Abdou et al. (2023) illustrate the mediating role of GWE in the hospitality sector, showing that green inclusive leadership enhances green work engagement, which in turn promotes organizational citizenship behavior and employee retention. Despite this growing body of evidence, a unified empirical model linking green training, green work engagement, and

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employee retention remains underexplored. The interdependent relationship among green HRM, employee engagement, and sustainable practices represents a crucial strategy for businesses (Moran et al., 2025).

Table 1: Empirical studies on Green Training, Engagement, and Retention

Author(s) & Year	Context / Industry	Method	Key Results
Jabbour (2011)	Review of organisations adopting green HRM	Literature review	Highlighted GT as central to embedding sustainability in HRM; suggested positive links with employee outcomes, though empirical evidence is limited.
Paillé, Chen, Boiral, & Jin (2014)	Chinese manufacturing	Survey + SEM	HRM practices (including green training) predicted environmental performance; employee engagement partially mediated effects.
Guerci, Longoni, & Luzzini (2016)	Italian firms	Survey + SEM	Green HRM practices influenced environmental performance via employee involvement and motivation.
Al-Hajri (2020)	Omani service industry	Survey	Training had a significant positive effect on employee retention; it highlighted training as a retention strategy.
Aboramadan (2020)	Higher education (Palestine)	Survey + SEM	Green HRM (training, involvement) positively influenced green work engagement, which mediated green behaviours.
Huo, Li, Zheng, Liu, & Yan (2022)	Chinese firms	Survey + SEM	GT positively affected green behaviours, mediated by green commitment.
Han & Kok (2023)	Meta-analysis across industries	Meta-analysis	Green HRM had overall positive links to sustainability outcomes; mediators like engagement and satisfaction were critical.
Haque, Gopal, & Singh (2024)	Indian firms	Survey + PLS-SEM	GT significantly influenced organizational performance; engagement mediated the effect.
Judeh & Khader (2023)	Jordanian service firms	Survey + SEM	Green HRM positively influenced employee retention through engagement.
Hassanein, Elshaer, & Azazz (2024)	Tourism sector (Egypt)	Survey + SEM	Green HRM increased retention via job satisfaction; suggested multiple mediators beyond engagement.
Present Study (2025)	Manufacturing and service sector, Bangladesh	Survey + PLS-SEM (SmartPLS)	Direct effects: GT → ER $\beta = .597$ ($p < .001$); GT → GWE $\beta = .584$ ($p < .001$); GWE → ER $\beta = .468$ ($p < .001$). Mediation: GWE partially mediates GT–ER (indirect $\beta = .273$, $p < .01$). Confirms GT impacts retention directly and indirectly via engagement.

Source: Authors developed.

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3. Model Specification and Hypotheses of the Study

Based on the objectives of the study and the reviewed literature, the intended hypotheses are as follows:

Hypothesis No.	Hypotheses Statements
H1:	GT is significantly associated with Employee Retention.
H2:	GT is significantly associated with Green Work Engagement.
H3:	GWE is significantly associated with Employee Retention.
H4:	GWEsignificantly mediates the relationship between GT and Employee Retention.

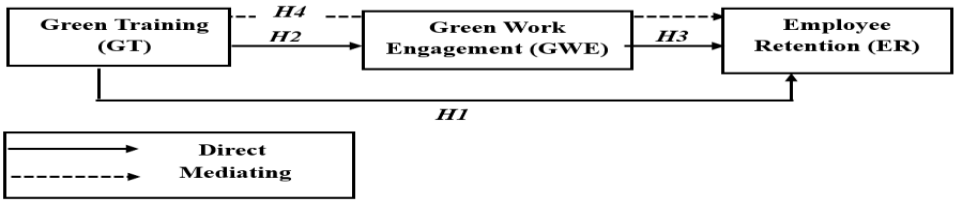

Figure 1. Conceptual Framework (Source: Authors developed)

4. Research Methodology

The research is descriptive in nature and was carried out using a quantitative methodology. A survey employing a 5-point Likert scale questionnaire was used to gather quantitative data for this investigation (the complete questionnaire used in this study is provided in Appendix A). Bangladeshi garment workers at all levels are the study's target population. The garment industry was selected due to its labor-intensive nature, high employee turnover, and increasing environmental compliance requirements, making it a suitable context for examining green HRM practices. Since the majority of Bangladesh's garment factories are situated in the Dhaka division, the sampling frame for this study is made up of these factories. This study was carried out using basic random probabilistic sampling since the population of the apparel industry is well-known. The sample size is 237.

Structured closed-ended questionnaires have been used to collect primary data. Each question is scored on a 5-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree." The targeted participants received questionnaires via pick-and-drop and Google Form. Respondents included employees from different organizational levels (managerial, supervisory, and operational), allowing a comprehensive assessment of green training**.** Using various search engines, secondary data were gathered for this study from appropriate journals, pertinent reports, and online articles.

The dependent variable is employee retention (ER), the independent variable is green training (GT), and the mediating variable is GWE. Employees working in

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factories implementing formal green HR practices (e.g., LEED-certified units) are considered direct beneficiaries of GT initiatives. The gathered data have been analyzed and summarized using SMART PLS-4. There were four sections on the questionnaire. The demographic factors were discussed in the first section. Seven questions were then included in the second section to gather GT data. Nine questions made up the third section, which was used to gather GWE data. Ten questions were included in the last section to gather information on ER. The inclusion of these items directly addresses the concern regarding questionnaire transparency. Data has been coded in Microsoft Excel for analysis. Demographic analysis has been conducted using SPSS 27. PLS-SEM has been applied to testing hypotheses and measurement models. The study's findings have been displayed in various tables.

5. Data Analysis and Discussion

5.1 Demographic Analysis

Respondents' characteristics, such as level of education, age, gender, type of working company, position, and experience, are shown in Table 2.

Table 2. Demographic information of the respondents

Category		Frequency	Percentage (%)
Level of Education	SSC	14	5.9
	HSC	20	8.4
	Bachelor	114	48.1
	Master	89	37.6
Age	Less than 20	12	5.1
	20–30	69	29.1
	31–40	88	37.1
	More than 40	68	28.7
Marital Status	Single	64	27.0
	Married	173	73.0
Gender	Male	149	62.9
	Female	88	37.1
Type of Company	LEED Certified	79	33.3
	Not Certified by LEED	158	66.7
Position	Chairman/MD/Vice Chairman/DMD/CEO/COO/Director	15	6.3
	GM/Managers/Executive Officer	137	57.8
	In charge/ Line Chief/Supervisor	61	25.7
	Operator/ Assistant Operator/Labor	24	10.1

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Category		Frequency	Percentage (%)
Experience	5–10 years	114	48.1
	11–15 years	72	30.4
	16–20 years	31	13.1
	More than 20 years	20	8.4

Source: Authors Developed

The data show that most of the people who answered the survey (48.1%) have bachelor's degrees, and 37.6% have master's degrees. Prior research indicates that education significantly influences employees' comprehension of organizational practices, commitment, and adaptability to sustainability initiatives (Paillé et al., 2014; Jabbour, 2011). The high level of education in this group shows that the people who answered the questions have the knowledge they need to understand and support GHRM practices. Most of the employees are between the ages of 31 and 40 (37.1%), followed by those between the ages of 20 and 30 (29.1%) and those over the age of 40 (28.7%).

This indicates that the majority of the sample comprises early to mid-career professionals, corroborating previous studies that link younger workforces to enhanced adaptability and receptiveness to organizational change, including sustainability initiatives (Albrecht et al., 2015; Guerci et al., 2016). Adding senior staff to the dataset makes it better because longer tenure is often linked to more commitment and embeddedness in the organization (Ng & Feldman, 2010). The gender distribution (62.9% male and 37.1% female) reflects a male-dominated workforce, aligning with the industrial backdrop prevalent in several developing economies. The significant involvement of women indicates a growing inclusivity and diversity within organizational environments, which has been demonstrated to enhance innovation and engagement (Ali, et al., 2015).

Concerning organizational type, two-thirds (66.7%) of respondents were employed by non-LEED certified enterprises, whilst one-third (33.3%) were affiliated with LEED-certified organizations. This version guarantees representation from both traditional and sustainability-focused enterprises. Previous research indicates that employees at firms with environmental certifications often demonstrate more involvement and alignment with green HRM practices (Renwick, 2013; Guerci et al., 2016). The distribution of roles indicates that the predominant group consists of managers and executives (57.8%), followed by supervisors (25.7%). Middle management is essential, as it is frequently regarded as the primary catalyst for executing HRM strategies and fostering employee engagement (Appelbaum et al., 2000). The inclusion of both frontline personnel and upper management bolsters the credibility of the opinions obtained. The experience profile indicates that over half (48.1%) possess 5–10 years of experience, whereas 30.4% have 11–15 years. This signifies a workforce

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that is both seasoned and comparatively stable, consistent with previous research indicating that employees with middling tenure exhibit higher engagement and lower turnover intentions than those who are either newly hired or nearing retirement (Ng & Feldman, 2010). The demographic attributes of this sample indicate a knowledgeable, diversified, and organizationally integrated workforce, hence enhancing the validity of this study.

5.2 Analysis of Measurement Model (MM)

After running the PLS algorithm with the constructs and their respective indicators, items with insufficient factor loadings (<0.70) were excluded (Wong, 2013). This item purification process follows established PLS-SEM guidelines and does not compromise the conceptual integrity of the constructs. The final model retained four indicators for GT, eight indicators for GWE, and seven indicators for Employee Retention (ER). The detailed loadings, VIF values, and construct-level reliability and validity scores are presented in Table 3.

From Table 3, it is evident that all three constructs demonstrate strong internal consistency and reliability. Cronbach's Alpha values exceeded the recommended threshold of 0.70 for each construct (GT = 0.764; GWE = 0.875; ER = 0.878), indicating reliable scales (Hair et al., 2021). Similarly, Composite Reliability (CR) values were above 0.80 in all cases (GT = 0.849; GWE = 0.903; ER = 0.905), further supporting construct reliability.

Convergent validity was also established, as all Average Variance Extracted (AVE) values exceeded the cut-off of 0.50 (GT = 0.585; GWE = 0.572; ER = 0.577), suggesting that the retained indicators sufficiently explain their respective constructs (Fornell & Larcker, 1981). At the indicator level, factor loadings were consistently above 0.70 (ranging from 0.713 to 0.793 for GT, from 0.713 to 0.787 for GWE, and from 0.721 to 0.783 for ER), except for a few marginally lower values (e.g., ER7 = 0.721; GWE4 = 0.713). Since these items were conceptually important and their inclusion did not compromise the model's overall validity, they were retained**.** This decision aligns with prior PLS-SEM research recommending retention of theoretically meaningful indicators when reliability and validity thresholds are satisfied (Hair et al., 2021).

Multicollinearity was not an issue. All outer-model VIF values fell between 1.379 and 1.987, well below the critical threshold of 5 (Hair et al., 2021). Inner-model VIF values for the paths (GT → ER, GT → GWE, GWE → ER) also remained low (≤ 1.517), confirming that collinearity does not bias the regression estimates.

In summary, Table 3 demonstrates that the measurement model meets the criteria for reliability, convergent validity, and absence of multicollinearity, allowing us to proceed confidently to the assessment of discriminant validity and the structural model.

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Table 3. Factor loadings, reliability, convergent validity, and VIF analysis

Construct / Indicator	Factor Loading	VIF	Cronbach's α	CR (ρc)	AVE
Green Training (GT)			0.764	0.849	0.585
GT1	0.793	1.595			
GT2	0.771	1.547			
GT3	0.753	1.401			
GT6	0.741	1.379			
Green Work Engagement (GWE)			0.875	0.903	0.572
GWE1	0.787	1.987			
GWE2	0.748	1.823			
GWE3	0.775	1.808			
GWE4	0.713	1.592			
GWE6	0.757	1.902			
GWE7	0.746	1.848			
GWE8	0.763	1.875			
Employee Retention (ER)			0.878	0.905	0.577
ER1	0.774	1.851			
ER2	0.783	1.984			
ER4	0.765	1.824			
ER5	0.775	1.932			
ER6	0.752	1.759			
ER7	0.721	1.708			
ER10	0.743	1.742			

Notes: Factor loadings, Cronbach's α, Composite Reliability (CR), and Average Variance Extracted (AVE) were assessed following recommended thresholds (Hair et al., 2021; Fornell & Larcker, 1981). Items with factor loadings below 0.70 were considered for removal (Wong, 2013). Variance Inflation Factor (VIF) values below 5 confirm the absence of multicollinearity (Hair et al., 2021).

5.3 Discriminant Validity — Table 4 & Table 5

To establish discriminant validity, the Fornell–Larcker criterion (1981), the HTMT ratio, and cross-loadings were assessed. Table 4 presents the Fornell–Larcker criterion, where the square root of AVE for each construct is shown along the diagonal. These diagonal values are higher than the corresponding inter-construct correlations in the rows and columns. For example, the square root of AVE for Employee Retention (ER) is 0.759, which is greater than its correlations with GT (0.597) and GWE (0.657). Similarly, the square roots of AVE for GT (0.765) and GWE (0.756) are larger than their respective inter-construct correlations. These results confirm that each construct is distinct from the others.

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Table 4. Discriminant validity analysis (Fornell–Larcker criterion)

Construct	ER	GT	GWE
ER	0.759		
GT	0.597	0.765	
GWE	0.657	0.584	0.756

Table 5 provides the HTMT ratios. All HTMT values were below the conservative threshold of 0.90 (Henseler et al., 2015), with ER–GT = 0.725, ER–GWE = 0.743, and GT–GWE = 0.709. This supports discriminant validity. Taken together, the Fornell–Larcker criterion, HTMT ratio, and cross-loadings provide robust evidence that the constructs of GT, GWE, and ER is empirically distinct.

Table 5. Discriminant validity analysis (HTMT ratio)

Construct	ER	GT	GWE
ER	—	0.725	0.743
GT	—	—	0.709
GWE	—	—	—

Notes*:* The Fornell–Larcker criterion requires the square root of AVE to exceed inter-construct correlations (Fornell & Larcker, 1981). The HTMT ratio should remain below 0.90 to confirm discriminant validity (Henseler et al., 2015).

5.4 Assessing the Structural Model

After verifying the measurement model's reliability and validity, the structural model was examined using SMART PLS 4.0 with bootstrapping. A total of 5,000 sub-samples were used to generate standard errors, t-values, and p-values. The acceptance or rejection of each hypothesis was determined by assessing these values for each proposed path. This procedure ensures rigorous hypothesis testing consistent with contemporary SEM best practices**.** The results demonstrate that H1 is supported, i.e., GT is positively associated with Employee Retention (ER) ($\beta = 0.323$, $t = 2.863$, $p < 0.05$). Similarly, H2 is supported, showing that GT is positively associated with GWE ($\beta = 0.584$, $t = 7.173$, $p < 0.05$). Finally, H3 is also supported, confirming that GWE is positively associated with ER ($\beta = 0.468$, $t = 4.267$, $p < 0.05$).

Table 6. Hypotheses testing.

Paths	Path Coefficient (β)	t-Statistics	p-Values	Status
H1: GT → ER	0.323	2.863	0.004	Accepted
H2: GT → GWE	0.584	7.173	0.000	Accepted
H3: GWE → ER	0.468	4.267	0.000	Accepted

Notes*:* Path coefficients, t-values, and p-values were obtained at the 5% significance level via SmartPLS bootstrapping with 5,000 sub-samples (Hair et al., 2021; Wong, 2013).

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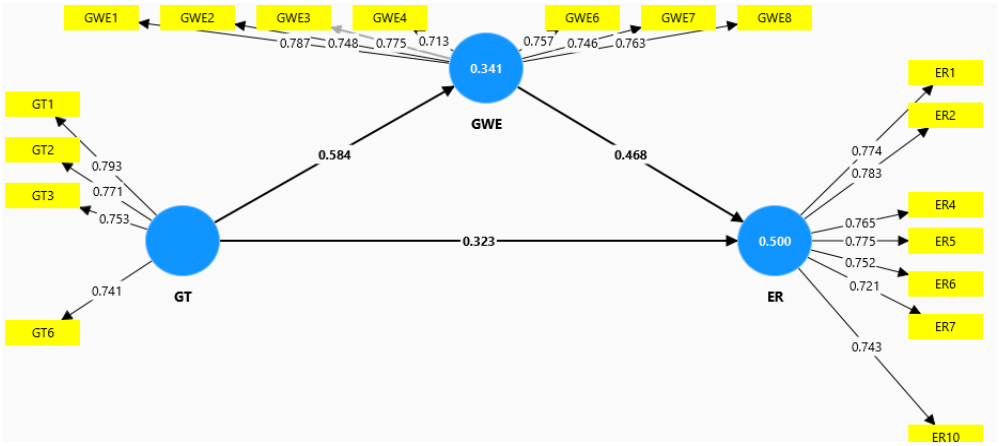

Figure 2. Final output model. (Source: Results from Data Analysis)

5.5 Mediation Analysis

The study further investigated how GWE mediates the relationship between GT and Employee Retention (ER) (H4). The results of the mediation analysis are presented in Table 7.

The findings reveal that GT has a significant total effect on ER ($\beta = 0.596$). Considering the direct effect, GT also shows a significant positive relationship with ER ($\beta = 0.323$, $t = 2.863$, $p < 0.05$). Lastly, GWE demonstrates a significant indirect effect between GT and ER ($\beta = 0.273$, $t = 3.466$, $p = 0.001$), confirming its mediating role. Since both the direct and indirect paths are significant, the results indicate that GWE partially mediates the relationship between GT and ER. Therefore, H4 is supported. This directly provides clarity and empirical verification of the mediating mechanism.

Table 7. Mediation analysis.

Effect Type	Path	Path Coefficient (β)	t-Statistics	p-Values	Mediation Status
Total Effect	GT → ER	0.596	6.578	0.000	Significant
Direct Effect	GT → ER	0.323	2.863	0.004	Significant
Indirect Effect	GT→ GWE→ ER	0.273	3.466	0.001	Partial Mediation (Accepted)

Notes**:** Mediation was tested using bootstrapping procedures, following guidelines in Hair et al. (2021). Significance of the indirect effect was confirmed as the bias-corrected confidence interval did not include zero (Hair et al., 2021). Since both direct and indirect effects were significant, mediation is partial.

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5.6 Discussion of the Hypotheses

H1: GT → ER

Results indicate that GT has a significantly positive effect on ER ($\beta = 0.597$, $p < 0.001$). This is in line with the true spirit of Social Exchange Theory (Blau, 1964), which shows that to the extent that employees feel valued due to an investment from an organization (e.g., through shared training), the more they will reciprocate with loyalty and retention. Training provides continued organizational concern for employees, which enhances job satisfaction and reduces turnover (Jabbour, 2011). Previous studies also indicate that training, as a green HRM practice, enhances employees' commitment and reduces turnover (Guerci, Longoni, & Luzzini, 2016).

H2: GT → GWE

In the study, GT was indeed found to be a significant positive predictor of GWE ($\beta GT = 0.584$; $p < 0.001$). This lends credence to the ability-motivation-opportunity (AMO) framework (Appelbaum et al., 2000), which posits that HRM practices enhance employees' ability (A), increase their motivation (M), and provide them opportunities (O) to perform well at work. GT equips employees with the knowledge and competencies they need, but it also encourages them to develop eco-friendly practices. Previous studies support this relation: Saks (2006) showed that training contributes to work engagement through psychological empowerment, and Paillé et al. The (2014) study shows that by enhancing the implementation of green HRM activities, the employees' level of environmental involvement and participation is enabled to grow.

H3: GWE → ER

The findings validated that GWE had a beneficial effect on ER ($\beta = 0.468$, $p < 0.001$). This aligns with the research of Schaufeli and Bakker (2004), who posited that engaged employees demonstrate greater organizational commitment and are less inclined to go. Engagement, characterized by vigor, dedication, and absorption (Schaufeli et al., 2002), serves as a psychological buffer against turnover intentions. Albrecht et al. (2015) further asserted that engaged employees experience a heightened alignment with the organization, which directly improves retention outcomes. Thus, GWE emerges as a critical psychological mechanism linking green HRM practices to employee retention outcomes.

H4: Mediation (GT → GWE → ER)

The mediation analysis indicated that GWE partially mediates the association between GT and ER ($\beta = 0.273$, $p = 0.001$). This indicates that GT affects ER both directly by improving abilities and indirectly by promoting participation. The partial mediation corroborates previous findings by Paillé et al. (2014), who identified that involvement mediates the connection between HRM practices and sustainability outcomes. This aligns with Hair et al. (2021), who propose that partial mediation underscores the existence of many pathways connecting HRM practices to organizational results.

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5.7 Theoretical Implications

This research offers multiple theoretical contributions. This research enhances Green HRM literature by demonstrating that GT affects retention not only directly but also indirectly through engagement, thus unifying the fields of human resource development and sustainability. By empirically validating this mechanism within a labor-intensive manufacturing context, the study extends the applicability of Green HRM theory to emerging-economy industries. Secondly, it corroborates the Social Exchange Theory by illustrating that employees react favorably to corporate investment in environmental training. Third, utilizing the AMO framework, this study demonstrates how HRM approaches can concurrently augment ability, motivation, and opportunity to boost retention.

5.8 Practical Implications

The findings have implications for management practices. While organized GT programs directly contribute to employee retention, they also indirectly contribute to green workplace engagement. This implication is particularly relevant for garment-sector organizations facing high employee turnover and increasing sustainability compliance pressures. Second, training design should include motivational elements in addition to training in technical competencies, e.g., working toward purpose, environmental engagement, and recognition of pro-environmental behaviours. Third, as engagement has a tremendous impact on retention, managers should create an enabling environment that fosters employee engagement in sustainability practices. In the end, GT as part of a holistic HRM strategy can improve corporate reputation and recruit personnel with a sustainability-oriented mindset, which in turn, will strengthen long-term retention as well (Renwick, 2013).

Table 8. Summary of Findings, Literature Links, and Implications

Finding	Literature Link	Implication
H1: GT → ER ($\beta = 0.597$, $p < 0.001$) GT has a significant positive effect on Employee Retention.	Consistent with Social Exchange Theory (Blau, 1964), employees reciprocate organizational investment in training with loyalty.supported by Jabbour (2011) and Guerci et al. (2016), who found that green HRM practices enhance retention. This evidence confirms the relevance of GT as a retention mechanism in sustainability-driven industries.	Organizations should invest in structured GT programs to directly improve retention by signaling commitment to employee development and sustainability.
H2: GT → GWE ($\beta = 0.584$, $p < 0.001$) GT strongly enhances Green Work Engagement.	Training enhances ability, motivation, and opportunity (AMO theory, Appelbaum et al., 2000). Saks (2006) and Albrecht et al. (2015) show that training increases engagement by building purpose and capability. Paillé et al. (2014) emphasize the role of green HRM in fostering engagement with sustainability practices. This highlights engagement as a central psychological outcome of GT interventions.	GT should be designed not only for skills but also to inspire purpose, enthusiasm, and commitment to sustainability, thus fostering engagement.
H3: GWE → ER ($\beta = 0.468$, $p < 0.001$) Green Work	Engagement is linked to lower turnover and higher commitment (Schaufeli & Bakker, 2004; Saks, 2006). Albrecht et al. (2015) stress that engaged employees	Managers should foster engagement initiatives (recognition, teamwork,

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Finding	Literature Link	Implication
Engagement significantly predicts Employee Retention.	remain with organizations longer. This finding reinforces engagement as a critical retention lever across organizational contexts.	purpose-driven tasks) to keep employees motivated and loyal.
H4: GT → GWE → ER ($\beta = 0.273$, $p = 0.001$) GWE partially mediates the relationship between GT and ER.	Partial mediation confirms dual impact: direct and indirect (Hair et al., 2021). Paillé et al. (2014) found engagement mediates HRM practices and environmental performance outcomes**.** This directly addresses a clearer articulation of the mediating mechanism.	Organizations should integrate GT with engagement programs to maximize retention outcomes. Engagement acts as the psychological pathway linking training to retention.

6. Limitations and Future Research Directions

While this study offers significant insights into the role of GT in improving employee retention via green work engagement, several limitations must be recognized.

First, the study used a cross-sectional design, which makes it hard to draw strong conclusions about cause and effect. The findings indicate substantial direct and indirect relationships; however, engagement and retention are dynamic constructs that may change over time. Subsequent research ought to utilize longitudinal or experimental methodologies to elucidate the progression of the effects of GT and to determine if engagement maintains its mediating function over time (Suleman, Syed, & Mahmood, 2023; Han & Kok, 2023).

Second, the data were gathered from a singular national context (Bangladesh) and confined to specific industries. While this offers depth and contextual significance, cultural and institutional influences may affect employees' perceptions of green HRM practices. To determine the generalizability of these findings, comparative studies across various countries and sectors are essential (Renwick, 2013).

Third, the study concentrated solely on GWE as the mediating variable. However, other attitudinal variables, including job satisfaction, organizational commitment, green organizational climate, and empowerment, may also elucidate the GT–ER relationship (Paillé, et al., 2014; Hassanein et al., 2024). Subsequent research may employ a multi-mediator or serial mediation framework to more effectively elucidate the psychological mechanisms by which GT influences retention.

Fourth, the dependence on self-reported survey data may result in common method bias and social desirability effects. Even though statistical fixes were used, future research might benefit from using data from more than one source (like supervisor evaluations or HR retention records) or a mix of methods to confirm results (Hair et al., 2021).

Lastly, the study did not examine possible moderating variables that could enhance or diminish the identified relationships. Green organizational culture,

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leadership style, generational differences, and LEED certification status may influence the degree to which GT results in engagement and retention (Guerci, et al., 2016; Judeh & Khader, 2023). Subsequent research ought to examine these moderators to enhance theoretical comprehension and inform context-specific human resource management strategies. In conclusion, this study validates the dual mechanism by which GT improves retention—both directly and indirectly through engagement—while also presenting multiple opportunities for future research. Longitudinal, cross-cultural, and multi-mediator studies, along with a broader array of data sources and moderator analyses, will be essential in enhancing both theoretical and practical comprehension of the role of green HRM practices in sustainable workforce management.

7. Conclusion and Recommendations

As companies deal with global sustainability issues and pressures on their workers, it has become more important for them to include GT in their daily activities. GT not only teaches employees about the environment, but it also makes them more loyal to the company and less likely to leave (Jabbour, 2011; Al-Hajri, 2020), signifies commitment, promotes reciprocity, and enhances retention (Blau, 1964; Guerci, et al., 2016). An increasing number of research also emphasizes the mediating function of GWE in elucidating the mechanism through which GT leads to favorable employee outcomes. Engagement, defined by vigor, dedication, and immersion in environmentally-related tasks, links training to long-term workforce stability by augmenting employees' sense of purpose and alignment with organizational values (Aboramadan, 2020). The Job Demands–Resources model and the Ability–Motivation–Opportunity framework say that well-designed training programs can be both resources and motivators, which can help keep employees (Saks, 2006). This research underscores the increasing acknowledgment that sustainability-oriented HR practices are not only advantageous for the environment but also crucial for organizational competitiveness and employee engagement (Suleman, et al., 2023). Accordingly, the findings provide actionable insights for both manufacturing and service-sector organizations seeking to align sustainability initiatives with long-term human capital strategies.

8. Recommendations

8.1 For Practice

Make green training a strategic investment - Companies should create GT programs that focus on both environmental skills and employee development. This shows a long-term commitment and encourages loyalty (Al-Hajri, 2020). This recommendation is particularly relevant for labor-intensive industries such as the garment sector, where employee turnover remains a persistent challenge.

Encourage participation by providing useful training – Value focused and goal focused GT should be set up in the organization. So the employees feel energized and dedicated to their work (Aboramadan, 2020; Saks, 2006). Such

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engagement-oriented training designs strengthen the mediating role of GWE identified in this study.

Implement a comprehensive green HRM system - Combining GT with other eco-friendly practices, like eco-friendly hiring, evaluation, and reward systems, creates synergies that improve engagement and retention (Guerci, Longoni, & Luzzini, 2016; Tang et al., 2018). An integrated approach ensures that GT is reinforced through consistent HRM signals rather than operating in isolation.

Make leadership and culture stronger - Managers should set an example by acting in ways that are good for the environment and encourage others to do the same. This is because leadership commitment makes training more effective at keeping employees (Renwick, 2013; Judeh & Khader, 2023**).** This is especially important in organizations transitioning toward formal sustainability standards, such as LEED certification.

Look at how well the training worked - To make sure that GT outcomes are in line with the goals of the organization and the workforce, they should be checked regularly through surveys, retention indicators, and employee feedback (Hair et al., 2021). Continuous evaluation allows organizations to refine GT strategies and sustain engagement-driven retention benefits over time.

8.2 For Research

Investigate supplementary mediators - There may be other factors at work with GWE, like job satisfaction, organizational commitment, and empowerment, that should be looked at in multi-mediator models (Paillé, Chen, Boiral, & Jin, 2014; Hassanein, et al., 2024**).** Such extensions would deepen understanding of the psychological mechanisms underlying green HRM practices.

Look at the moderators - Factors like an organization's green culture, differences between generations, and certification standards (like LEED) could make it easier to understand boundary conditions (Guerci et al., 2016). This would help distinguish between direct and indirect beneficiaries of green HRM initiatives.

Use longitudinal designs - Longitudinal studies are necessary to evaluate the durability of gamification effects on engagement and retention (Han & Kok, 2023). Such designs would also strengthen causal inference, addressing a key methodological limitation noted by the reviewer.

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Appendix A. Measurement Instrument

Table A1. Measurement Instruments

Construct	Item Code	Measurement Item	Source
Green Training (GT)	GT1	The firm develops training programs in environmental management to increase the environmental awareness, skills, and expertise of the employees.	Dumont et al., (2017), Islam et al., (2020)
	GT2	The firm provides integrated training to foster employees' emotional commitment to environmental management.	Tang et al., (2018)
	GT3	Contents of GT are raised through a systematic analysis of training gaps and needs.	Tang et al., (2018)
	GT4	Environmental training is a priority when compared to other types of company training.	Dumont et al., (2017)
	GT5	The responsibilities and duties of official green trainers are precisely defined.	Jabbour (2011)
	GT6	There is an adequate infrastructure (physical space, material, and people) for the delivery of GT.	Tang et al. (2018)
	GT7	There are adequate assessments of employees' performance after attending GT sessions.	Dumont et al., (2017)
Green Work Engagement (GWE)	GWE1	I understand the concept of Green HRM practices, and I am aware of them.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE2	I welcome Green HRM concepts and practices in the organization.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE3	I feel happy when I am working intensely in a green environment.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE4	My environment-related tasks inspire me.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE5	I am proud of the environmental work that I do.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE6	I am fully engaged in my environmental work.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE7	I am enthusiastic about my environmental tasks at my job.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)

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Construct	Item Code	Measurement Item	Source
	GWE8	I feel bursting with energy in my environmental tasks.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
	GWE9	I find my work full of meaning and purpose.	Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006)
Employee Retention (ER)	ER1	In order to support this company's success, I'm willing to work far harder than is often required.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER2	I feel a lot of loyalty to this company.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER3	If I wanted to do another job or function, I would look first at the possibilities within this company.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER4	I would recommend this company to a friend if he/she is looking for a job.	Eric Ng Chee Hong et al.,2012.
	ER5	I am satisfied with the greenery initiatives of my organization and intend to stay here in the long run.	Eric Ng Chee Hong et al.,2012.
	ER6	I am happy and comfortable with my environmental work in this organization.	Eric Ng Chee Hong et al.,2012.
	ER7	I have no intention to leave the company soon.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER8	I see a future for myself within this company.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER9	I think I will never leave this firm.	Minjoon, J., Cai, S., & Shin, H. (2006)
	ER10	This is the best garments company for me to work with.	Context-adapted from Kundu & Gahlawat (2016)

Note: All items were measured using a 5-point Likert scale ranging from 1 = “Strongly Disagree” to 5 = “Strongly Agree”. The items were adapted from established scales in prior Green HRM, employee engagement, and retention literature and contextualized for the Bangladeshi garment industry.

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