
BRIDGING THE DIGITAL GAP: AN ANALYSIS OF SMART CARD USAGE AND ITS DETERMINANTS

Sujit Kumar Mahato¹ and Dr. Kushal De^{2*}

¹Assistant Professor of Commerce, Budge Budge College, C/E 24 25 Rabindranagar Road, PO- Bartala, PS- Rabindranagar, Kolkata- 700018, West Bengal

^{2*}Assistant Professor of Commerce, Dhruva Chand Halder College, E1/7a, Ramgarh, PO- Naktala, Kolkata- 700047, West Bengal

¹sujit25mahato@gmail.com and ^{2*}dekushal1979@gmail.com

ABSTRACT

Smart cards offer versatile solutions for various applications such as identification, telecommunication, transportation, healthcare, financial transaction etc. The youths are the most prominent groups using smart cards for easy access to services and financial transactions. Smart card's increasing significance is directly related to India's cashless and digital economy. Government programme such as the "Digital India" campaign encouraged the use of digital payment systems, including smart cards. The present study aims to analyse the key factors influencing the usage of smart cards among the youth and see if gender or income of the respondents have any significant impact in this issue. A structured closed-ended questionnaire was used to collect data from 211 respondents from three districts of West Bengal. The collected data were analysed by using statistical tools such as Factor Analysis, Mann-Whitney U test, Kruskal-Wallis H test. The results indicate that critical factors influencing smart card usage are security, support, satisfaction, awareness and governance. It is found that the female respondents expressed greater concern for security. Significant differences were also found in awareness level across income groups. Respondents with lower income showed less familiarity with smart cards. The study clearly demonstrates the impact of various independent factors on usage among the selected population.

Keywords: *satisfaction, security, smart card, support, youth.*

1. INTRODUCTION

Smart card technology has become an integral part of modern life. It offers versatile solutions for various applications such as identification, telecommunication, transportation, healthcare, financial transaction etc. The successful implementation and widespread usage of smart cards depend on several factors including usefulness, security, ease-of-use, awareness, support, satisfaction and cultural influence (Taherdoost, 2017). Smart card technology has evolved significantly over the past few decades. A smart card has integrated circuit chip card that can store and process data. Smart cards are becoming more secured due to advancement of technology (Selimis et al., 2009). It allows access to a system's database whether connected to the internet or not. Smart card revolutionises payment services by storing and processing large amounts of information while enhancing security (Hendry, 1997). In educational institutions, smart cards serve multiple purposes such as attendance tracking, payment processing, library access, class automation providing a unified solution for students (Jesani et al., 2020).

Youths are early adopters of technology. They are one of the most prominent groups using smart cards for easy access to services and financial transactions. The growing importance of smart cards is closely linked to the digitalisation and cashless economy in India. Government initiative such as the "Digital India" campaign promoted the adoption of digital payment methods, including smart cards. The use of smart cards significantly influenced by various individual factors like concern over security, level of user satisfaction, awareness of technology, governance mechanism and institutional support. Understanding these factors is vital to meet the challenges and improving the adoption of smart cards among users. The purpose of this study is to identify and analyse the key factors influencing the usage of smart cards among young adults residing in West Bengal. The study also highlights the difference in opinion based on demographic (gender) and socioeconomic (income groups) forces about using smart cards.

2. LITERATURE REVIEW

Chan (1997) in his study identified income as a key factor affecting the rate of credit card usage. Higher income levels are correlated with more frequent use of credit cards, indicating that income has a direct influence on the choice for and dependence on smart card payments. Martin et al., (2010) observed that the implementation of smart card technologies in government services often face public concerns. Concern about information security, personal privacy and the possibility of a national identification system can lead to lack of confidence.

Successful implementation in order to overcome these issues requires political transparency, community consultation and strong technological design. Orsquo et al., (2011) highlighted the impact of gender on credit card usage among university students in turkey, although the specific effects are not detailed. This emphasises the need for further study to understand how gender influences financial behaviour in different context. The study of Taherdoost et al., (2011) highlights that security is an important issue impacted smart card adoption especially in applications that handle sensitive data. The study found that strong encryption and temper resistant features of smart cards build confidence and promote acceptance. The study of Cheng & Chen (2016), highlights that initial card cost, transit fare, consumption discount, and personal information protection are considered as critical factors that affect the possible adoption rate of smart card use in transit systems. They also found that reducing transit fare and protecting personal information significantly impact the adoption rate of multipurpose smart cards in transit systems. The study of Taherdoost et al., (2013) showed that user’s awareness and understanding of smart card features significantly and directly affects user satisfaction of smart card technology. Study indicates that informed users are more likely to accept the technology. See-to (2014) found that income level has an impact on consumer’s attitude towards payment technologies, such as smart cards. These attitudes affect the usage of these payment methods both online and offline. Consumers with higher income may find smart cards more appealing and convenient thus increasing their usage. Dempsey (2015) found that smart cards involve a trade-off between privacy issues and the collection of useful data: the more useful the data the more intrusive the card becomes. People are concerned about possible misuse of their personal-information, security concerns continue to be a barrier. Yen et al. (2022) observed that males have higher performance expectations but females are often seen as more credible when it comes to the adoption of multipurpose national identity smart cards. This suggests that females may prioritize security and trust, whereas males focus on the utility and efficiency of technology.

3. OBJECTIVES AND METHODOLOGY

The objectives of the study are as follows:

1. To identify the key factors influencing the usage of smart cards among the youth.
2. To evaluate the impact of gender of the respondents on various factors affecting smart card usage. The impact of the income of the respondents on this issue is also assessed.

To fulfill the above objectives, a quantitative approach based on primary data collected from three districts of West Bengal namely Kolkata, South 24 pgs and Hooghly was employed. A total of 211 respondents were selected by the researchers. A structured closed-ended questionnaire was used to gather data. The data were tabulated in excel and analysed in SPSS 27. To find out the factors influencing the usage of smart cards, Principal Component Analysis has been applied. Kaiser-Meyer-Olkin (KMO) test has been conducted to check the adequacy of the underlying factors. Bartlett’s test of sphericity has been used to check the validity and suitability of the dataset used for factor analysis. The adequacy of the sampling and the presence of significant correlation among variables were also checked. Comparison between two groups to determine if there is any difference or not, Mann-Whitney U test has been applied. To determine the difference in opinion between more than two groups, Kruskal-Wallis H test has been deemed fit and applied.

4. FINDINGS AND ANALYSIS

The demographic profile of the sample is plotted in table below:

Table 1: Demographic Profile of the Respondent

Demographic profile	Categorical variable	Frequency	Percent (%)
Gender	Male	119	56.40
	Female	92	43.60
Family income	Less than 10,000	79	37.44
	10,000- 25,000	77	36.49
	25,000–50,000	27	12.80
	50,000-75,000	16	7.58
	75,000-1,00,000	10	4.74
	1,00,000 and above	2	0.95
Use of smart card	Multiple times daily	4	1.90
	Once daily	4	1.90
	Weekly	27	12.80
	Monthly	140	66.35

	Yearly	7	3.32
	Never used	29	13.74

Source: Primary Survey

The demographic profile of the respondents shows that there is a balanced gender representation in the sample. The income distribution also shows socio-economic diversity, which is essential for understanding income-based variations in smart card usage. The variation in usage frequency indicates different level of familiarity and reliance on smart cards.

Table 2: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure Of Sampling Adequacy.		.767
Bartlett's test of sphericity	Approx. Chi-square	924.392
	Df	231
	Sig.	.000

Source: Author Compilation

To ensure the suitability of the data set for factor analysis, the Kaiser-Mayer-Olkin (KMO) test and Bartlett’s Test of Sphericity were conducted. The KMO value for the dataset was 0.767 which suggests that the sample size is adequate for identifying underlying factors. Bartlett’s test showed a statistically significant correlation among the variables (p-value<0.05). The result of the KMO and Bartlett’s test validate that the dataset is suitable for factor analysis. The adequacy of the sampling and the presence of significant correlation among variables ensured the reliability of the data. This provides a strong foundation for identifying the critical factors influencing smart card usage.

Table 3: Rotated Component Matrix

Variables	Component				
	1	2	3	4	5
V1	.667				
V2	.661				
V3	.637				
V4	.627				
V5	.610				
V6		.692			
V7		.572			
V8		.549			
V9		.533			
V10		.504			
V11		.465			
V12			.728		
V13			.536		
V14			.498		
V15			.467		
V16				.676	
V17				.666	
V18				.529	
V19				.459	
V20					.701
V21					.640
V22					.557

Source: Author Compilation

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The Principal Component Method of factor analysis was applied to identify the underlying factors influencing smart card usage. The analysis reduced the data set of 22 variables into five critical factors namely Security, Support, Satisfaction, Awareness and Governance.

‘Security’ includes variables related to the perception of safety in transactions, protection against fraud and data privacy. ‘Support’ includes variables related to institutional support, such as customer service, technical assistance, and grievance redressal mechanism. ‘Satisfaction’ includes variables related with users’ satisfaction including ease of use, reliability, and the ability to meet users’ expectation. ‘Awareness’ includes variables measuring knowledge about smart cards; its features, benefits, and usage procedure. ‘Governance’ includes variables representing regulatory mechanisms, such as transparency, accountability, and overall efficiency of public services.

Table 4: Ranks

Factors	Gender of the respondent	N	Mean Rank	Sum of Ranks
Security	Male	119	94.90	11293.00
	Female	92	120.36	11073.00
	Total	211		
Support	Male	119	114.39	13613.00
	Female	92	95.14	8753.00
	Total	211		
Satisfaction	Male	119	105.91	12603.00
	Female	92	106.12	9763.00
	Total	211		
Awareness	Male	119	110.22	13116.00
	Female	92	100.54	9250.00
	Total	211		
Governance	Male	119	99.03	11785.00
	Female	92	115.01	10581.00
	Total	211		

Source: Author Compilation

The rank test was performed to analyse gender-based differences in perceptions of five identified factors influencing smart card usage. The findings are summarised below:

Factors	Mean Rank (Male)	Mean Rank (Female)	Key Insights
Security	94.9	120.36	Female respondents give significantly higher importance on security compared to male respondents. It suggests that women may be more cautious about security features, such as fraud prevention and data privacy when using smart cards.
Support	114.39	95.14	Male respondents valued support-related aspects, such as customer service and technical assistance higher than female respondents. It could indicate that men might depend more on institutional support while using smart cards.
Satisfaction	105.91	106.12	The similarity in mean ranks indicates that there was no significant gender based differences in satisfaction level with smart card usage.
Awareness	110.22	100.54	Male respondents showed slightly higher awareness of smart card features and benefits as compared to female respondents. It could reflect differences in exposure to or familiarity with the technology.

Governance	99.03	115.01	Female respondents emphasised more on governance factors, such as transparency, accountability and regulatory mechanism. It suggests that women may have higher expectations related to the fairness and efficiency of system.
-------------------	-------	--------	--

Table 5: Mann-Whitney U Test Statistics

(Grouping Variable: Gender of the respondent)

	Security	Support	Satisfaction	Awareness	Governance
Mann-Whitney U	4153.000	4475.000	5463.000	4972.000	4645.000
Wilcoxon W	11293.000	8753.000	12603.000	9250.000	11785.000
Z	-3.004	-2.272	-.025	-1.141	-1.885
Asymp. Sig. (2-tailed)	.003	.023	.980	.254	.059

Source: Author Compilation

From table 5, it is found that the significance values (p-values) for security, support, satisfaction, awareness and governance were 0.003, 0.023, 0.980, 0.254 and 0.059 respectively. The interpretations of these results are given below:

Security: The p-value for security was 0.003 which is less than the significance level 0.05. Female respondents placed significantly more importance on security. It indicates their concerns about fraud prevention and data privacy.

Support: The p-value for support was 0.023 which is also less than 0.05. It is seen that male respondents valued support related factors, such as customer service and technical assistance higher than females.

Satisfaction: The p-value for satisfaction was 0.980 which is greater than 0.05. This reflects that there is no statistically significant difference in satisfaction level between male and female respondents.

Awareness: The p-value for awareness was 0.254 which is greater than 0.05. This reflects that there is no statistically significant difference in awareness level between male and female respondents.

Governance: The p-value for governance was 0.059 which is slightly above the threshold limit of 0.05. Female respondents place slightly greater emphasis on governance factors such as transparency and accountability.

Table 6: Kruskal-Wallis H Test Statistics

(Grouping Variable: Family income of the respondents)

	Security	Support	Satisfaction	Awareness	Governance
Kruskal-Wallis H	1.494	3.581	5.706	11.772	1.586
Df	5	5	5	5	5
Asymp. Sig.	.914	.611	.336	.038	.903

Source: Author Compilation

The Kruskal-Wallis H test was conducted to examine differences in opinion of the five factors influencing smart card usage across different family income groups. The result revealed the following:

Security (p=0.914): There is no statistically significant difference in perceptions of security across different income groups. Respondents across all income levels express similar concerns about security in smart card usage. Security seems to be a universally significant factor unaffected by socio-economic status.

Support (p=0.611): Respondents from various income groups do not differ significantly in their opinion about institutional support. It suggests that support system such as customer service and technical assistance are valued equally across different income groups.

Satisfaction (p=0.336): There are no significant differences in satisfaction level with smart card usage across various income groups. Respondents from all income levels expressed similar level of satisfaction.

Awareness (p=0.038): A statistically significant difference was identified for awareness. Respondents from higher income groups showed greater awareness of smart cards, its benefits, features and functionality.

Governance (p=0.903): It suggests that opinion for governance related factors such as institutional efficiency, transparency and accountability are uniform across all income groups.

5. CONCLUSION

The rapid advancement of digital systems has made smart cards a crucial component for day to day activity. This study thoroughly examined the key factors influencing smart card usage such as security, support, satisfaction, awareness and governance. By applying various statistical techniques such as factor analysis, the Mann-Whitney U test and the Kruskal-Wallis H test, significant demographic and socio-economic based differences in opinion have been found. It emphasised the significance of customised solution to enhance the adoption of smart cards.

The principal component analysis reduced the complexity of data and identified the five critical factors influencing smart card usage among young adults. Each factor contributes in a specific way to understand smart card usage. These factors provide practical insights for raising acceptance rates. The result of the Mann-Whitney U test showed statistically significant differences in security and support factor based on gender. Security features should be enhanced to meet the expectations while robust support must be developed. Other factors such as satisfaction, awareness and governance were found to be equally significant for both genders.

The Kruskal-Wallis H test result revealed that based on family income, only 'awareness' showed statistical significance. It suggests that initiative for reducing the knowledge gap is essential. For other factors such as security, support, satisfaction and governance, the lack of significant differences suggests that initiative can be taken on these aspects uniformly across various income groups.

The study highlighted the role of demographic and socioeconomic factors influencing smart card usage among youth in West Bengal. The critical factors influencing smart card usage among youths were security, support, satisfaction, awareness and governance. The female respondents expressed greater concern for security while male respondents emphasised the importance of support. However, opinions for satisfaction, awareness and governance were gender neutral. Significant differences were also found in awareness level across income groups. Respondents with low income showed less familiarity with smart cards. Other factors were unaffected by income differences. The study though conducted on a small sample in a limited geographical area is significant as it clearly demonstrates the impact of various independent factors namely security, support, satisfaction, awareness and governance on smart card usage among the target population namely the youth.

6. RECOMMENDATIONS

Based on the findings the researchers propose the following measures to resolve the issue:

- Develop gender-sensitive strategies to meet the specific needs of male and female users.
- Conduct awareness program to spread knowledge of smart cards among lower income people.
- Ensure institutional transparency and strong governance mechanisms to foster trust and promote adoption.

Through the implementation of these suggestions, stakeholders such as financial institutions, policymakers and technology developers can encourage equitable and efficient use of smart card technology.

REFERENCES

1. Taherdoost, H. (2017). Appraising the smart card technology adoption; case of application in university environment. *Procedia Engineering*, 181, 1049-1057.
2. Selimis, G., Fournaris, A., Kostopoulos, G., & Koufopavlou, O. (2009). Software and hardware issues in smart card technology. *IEEE Communications Surveys & Tutorials*, 11(3), 143-152.
3. Hendry, M. (1997). *Smart Card Security and Applications*. Artech House, Boston, London.
4. Jesani, N., Gupta, N., Bhatt, S., Singh, P., & Saxena, A. (2020). Smart Card For Various Application In Institution. In *2020 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS)*, 1-5.
5. Taherdoost, E., Sahibuddin, S., & Jalaliyoon, N. (2012). Evaluation of User Awareness Affect on Smart Card Technology Satisfaction. *Computer Science*, 1, 1347-1351.
6. Çankaya, S., Ucal, M. Ş., & O'Neil, M. (2011). Effects of gender on credit card usage among university students in Turkey. *African Journal of Business Management*, 5(22), 9023-9030.
7. Taherdoost, H., Sahibuddin, S., & Jalaliyoon, N. (2011). Smart card security; Technology and adoption. *International Journal of Security*, 5(2), 74-84.

-
8. Elhennawy, A. P. M., & Amer, M. (2017). Smart Cards Structure and Applications: Emerging and Evolution. *ACS Advances in Computer Science*, 11 (1), 77-92.
 9. Martin, N. J., & Rice, J. L. (2010). Building better government IT: understanding community beliefs and attitudes toward smart card technologies. *Behaviour & Information Technology*, 29(4), 433-444.
 10. Yee-kwongChan, R. (1997). Demographic and attitudinal differences between active and inactive credit cardholders-the case of Hong Kong. *International Journal of Bank Marketing*, 15(4), 117-125.
 11. Yee Yen, Y., Yeow, P. H., & Wee Hong, L. (2022). Encouraging gender-inclusive acceptance of multipurpose national-identity smart cards. *PLoS ONE*, 17(7).
 12. See-To, E. W., Papagiannidis, S., & Westland, J. C. (2014). The moderating role of income on consumers' preferences and usage for online and offline payment methods. *Electronic Commerce Research*, 14, 189-213.
 13. Cheng, Y. H., & Chen, S. F. (2016). Adoption forecasting of multipurpose smart cards in transit systems. *Journal of Intelligent Transportation Systems*, 20(4), 363-384.