# LITERATURE REVIEW

* 1. **Introduction to the Literature Review**

**Context:** Customer loyalty programs are valuable tools that help businesses encourage repeat purchases and build strong relationships with their customers. These programs offer rewards and benefits that motivate customers to return, but managing multiple loyalty programs across different brands and stores can be complex. When customer data is spread across different systems, businesses struggle to get a full picture of their customers’ preferences and shopping habits, making it harder to create a personalized experience.

To address this, many businesses are looking for ways to combine data from various loyalty programs into a single system. A unified approach would allow them to better understand customer behavior and offer more targeted rewards. However, merging data from different sources brings its own challenges, such as ensuring compatibility, maintaining data privacy, and handling large amounts of information.

New technologies like neural networks and machine learning offer promising solutions to these challenges. Neural networks, for instance, can analyze customer behavior and make accurate predictions, enabling real-time personalization. By using these tools, businesses can create a unified membership system that not only enhances the customer experience but also provides deeper insights into customer behavior, allowing them to reward customers in more meaningful ways.

**Purpose of the Literature Review**

This literature review looks at creating a **unified membership system** using neural network technology. This approach has the potential to change how membership data is managed across different businesses. The purpose of this review is to explore if a system based on neural networks can centralize and handle membership data from many stores within a single application. This would mean customers no longer need multiple membership or loyalty cards, making membership management much easier.

The central idea of this research is that a neural network-based system can effectively combine and handle membership data from multiple businesses within one application. Neural networks excel in identifying complex patterns within data, making them well-suited for merging diverse membership data sources. For example, **adaptive-network-based fuzzy inference systems (ANFIS)** can process intricate data and adapt to new inputs, making them particularly useful for membership integration (Jang, 1993).

Using ANFIS for unified membership systems can be represented as follows:

where:

* represents adaptive weights for each data input,
* is the function mapping input data to an output relevant to the membership system,
* denotes the number of rules or conditions in the system.

This topic is important because a unified system could bring many benefits, such as better data management and a smoother experience for users. A neural network-based system could help businesses run more smoothly, improve customer experiences, and provide a simple way to manage membership data. This review also includes studies that show how neural networks are used in different areas, like multisensory integration, fuzzy logic, and neuro-fuzzy systems, which provide useful ideas for building a unified membership system ([Fang et al., 2019; Chhipa et al., 2021; Fu et al., 2015](https://www.sciencedirect.com/science/article/abs/pii/S0925231219307738?via%3Dihub)).

**Technical Aspects of the Unified Membership System**

The unified membership system is built on neural network technology, which is a type of artificial intelligence that works like the human brain by learning and adapting over time. Neural networks are good at processing large amounts of data and finding complex patterns, making them a great fit for managing membership data from multiple stores. By using advanced algorithms and deep learning techniques, neural networks can organize, analyze, and understand membership data to provide valuable insights for businesses.

The core of the system consists of a **data structure** that facilitates seamless integration of membership data. This structure includes data storage, processing modules, and visualization tools that collectively centralize and streamline membership information management. Neural networks help automate data entry, identify outliers or unusual patterns, and create personalized recommendations based on customer preferences and behaviors.

The data processing capabilities of neural networks can be expressed with the following function:

where:

* represents the current data output (e.g., recommendation or customer insight),
* ​ are past data values (autoregressive terms),
* ​ are past error terms (moving average terms),
* is the function determined by the neural network that maps these inputs to produce the desired output.

These techniques allow the system to handle large volumes of membership data, generate personalized recommendations, and detect unique customer behavior patterns. With real-time processing capabilities, the unified membership system can respond dynamically to changing customer needs, thereby increasing both customer satisfaction and loyalty.

* 1. Define Key Concepts and Theories

Customer loyalty programs are key strategies that businesses use to retain customers and build lasting relationships. These programs are designed to reward customers for their repeat purchases, fostering loyalty toward the brand. The main purpose of loyalty programs is to provide incentives, like points, discounts, or exclusive offers, which can be redeemed for rewards. This encourages customers to continue purchasing from the brand while also improving their experience by making them feel valued and appreciated ([Ou et al., 2011](https://www.emerald.com/insight/content/doi/10.1108/17506141111142825/full/html)).

Theories Supporting Customer Loyalty Programs

Several theories help explain why loyalty programs are effective in strengthening customer relationships and increasing retention:

* Relationship Marketing Theory:

Relationship marketing focuses on building long-term relationships with customers rather than just encouraging one-time sales. According to this theory, businesses that invest in nurturing relationships with their customers are more likely to retain them over time. Loyalty programs align with relationship marketing by creating incentives that encourage repeat interactions and foster a sense of connection with the brand ([Berry, 1995](https://link.springer.com/article/10.1007/s11747-015-0439-4)). The concept suggests that customers who feel valued and connected to a brand are less likely to switch to competitors.

* Social Exchange Theory:

Social exchange theory explains relationships as a series of give-and-take interactions where both parties seek to maximize rewards and minimize costs. In the context of loyalty programs, customers receive rewards (like points and discounts) in exchange for their continued business. This mutual exchange builds a sense of obligation, where customers feel more connected to brands that reward them. According to this theory, loyalty programs create a balanced relationship, where customers feel appreciated for their loyalty, leading to increased satisfaction and engagement Blau, (1964).

* Equity Theory:

Equity theory states that people are motivated by fairness and will seek balance in their exchanges. In loyalty programs, this balance is achieved when customers feel that the rewards they receive are fair for the purchases they make. When customers perceive that they are being treated fairly and are getting appropriate rewards for their loyalty, they are more likely to stay with the brand. This theory suggests that well-structured loyalty programs, which offer reasonable and valuable rewards, create a perception of fairness that fosters loyalty ([Adams, 1963](https://psycnet.apa.org/doiLanding?doi=10.1037%2Fh0040968)).

The formula representing customer perceived equity:

When this ratio aligns with customers' expectations, perceived fairness is high, supporting loyalty.

* Self-Determination Theory:

Self-determination theory emphasizes the importance of intrinsic motivation and the satisfaction of psychological needs. In loyalty programs, offering personalized rewards or experiences can enhance feelings of autonomy and competence, making customers feel more connected to the brand on a personal level. According to this theory, customers are more likely to stay loyal to brands that fulfill their needs for autonomy, relatedness, and competence through meaningful and tailored rewards ([Deci & Ryan, 1985](https://doi.org/10.1007/978-1-4899-2271-7)).

**Importance of Loyalty Programs**

Importance of Loyalty Programs

The importance of loyalty programs is supported by research showing that well-designed programs can boost customer satisfaction and trust, leading to stronger loyalty. For example, Ou et al. (2011) found that loyalty programs positively impact relationship quality, meaning that satisfied customers are more likely to remain loyal to the brand. Additionally, loyalty programs provide valuable data on customer preferences and behavior, allowing businesses to tailor their offerings and marketing strategies more effectively (*Analyzing the effect of perceived benefit of loyalty program towards program loyalty and customer loyalty*, 2018).

Role in Customer Engagement.

Loyalty programs also play a key role in enhancing customer engagement. By offering personalized rewards and unique experiences, businesses can create a deeper emotional connection with their customers. Research shows that when customers perceive high value in loyalty programs, their loyalty to the brand increases ([Kang et al., 2015](https://www.sciencedirect.com/science/article/abs/pii/S0148296314001994)). In a competitive market, loyalty programs help businesses stand out by showing that they understand and care about their customers’ needs. Programs that leverage social media and digital platforms can enhance this engagement further by creating interactive and community-focused experiences ([He et al., 2012](https://www.sciencedirect.com/science/article/abs/pii/S0148296311001020?via%3Dihub)).

Additional Benefits  
Beyond improving customer satisfaction and retention, loyalty programs can lead to higher customer spending and brand advocacy. Studies show that customers involved in loyalty programs tend to spend more, as they want to maximize the rewards they earn from purchases (Myftaraj, 2023). Loyalty programs also allow businesses to differentiate themselves, especially in markets with similar product offerings ([Hossain et al., 2017](https://www.sciencedirect.com/science/article/pii/S1877050917323037?via%3Dihub)).

A simplified formula representing the increased value from loyal customers might look like:

where:

* = total period of customer retention,
* = discount rate,
* **Loyalty Program Value** represents additional spending or advocacy resulting from the program.

This formula highlights how loyalty programs can add incremental value to customer lifetime value (CLV) through increased engagement and spending.

**Summary**

In summary, customer loyalty programs and membership systems are essential for businesses aiming to increase customer satisfaction, retention, and engagement. By offering personalized rewards and creating meaningful connections, these programs benefit both customers and businesses. The theories behind relationship marketing, social exchange, equity, and self-determination provide insight into why these programs are effective and highlight the value of understanding the principles that contribute to long-term customer loyalty.

## Review existing literature on neural network approaches for unified membership integration.

* + 1. Neural Network in Customer Behaviour Prediction.

The integration of neural networks for predicting customer behavior has gained significant attention in recent research due to their ability to analyze complex and nonlinear data patterns. Neural networks, particularly deep learning models, have been effectively applied in fields such as finance and retail to forecast customer actions, preferences, and market trends.

One key area of research is the use of neural networks in financial market predictions. For example, Feng and Xiao-e (2021) demonstrated that deep neural networks could effectively predict financial crises in stock markets using data mining techniques. Their findings highlight the strength of neural networks in managing financial risks, which is especially important for businesses operating in volatile environments. Similarly, Qiu and Shen (2016) explored optimized artificial neural networks for predicting stock market index movements, showing that these models could outperform traditional approaches like support vector machines (SVM) in time-series forecasting. This suggests that neural networks can capture complex relationships within financial data, making them valuable tools for market predictions.

In the context of predicting customer behavior, Cirqueira et al. (2019) outlined guidelines for preparing consumer transaction data to learn neural network embeddings, which are essential for understanding customer purchasing patterns in digital retail. Their research emphasizes that well-prepared data is crucial for improving the predictive accuracy of neural networks. Additionally, Hassanpour (2020) highlighted the effectiveness of hybrid models combining multiple machine learning techniques, such as convolutional neural networks (CNN) and recurrent neural networks (RNN), to predict foreign exchange market trends. This approach shows how neural networks can integrate various data sources, like technical indicators and financial news, to improve prediction outcomes.

The versatility of neural networks is also evident in their application for predicting customer churn. For instance, Salehinejad and Rahnamayan (2016) used recurrent neural networks to model customer shopping patterns, demonstrating the model's ability to capture time-based dependencies in customer behavior. Bahmani et al. (2013) developed a hybrid model combining genetic algorithms and neural networks to predict customer churn in telecommunications, highlighting the importance of accurate churn predictions for customer retention. Together, these studies suggest that neural networks enhance businesses' understanding of customer behavior, enabling them to implement targeted retention strategies.

Neural networks have also been shown to outperform traditional statistical models in stock market analysis. Fischer and Krauß (2018) compared the performance of long short-term memory (LSTM) networks to other models and found that LSTMs are especially effective in financial market predictions due to their ability to learn from sequential data. This aligns with the findings of Zhou et al. (2020), who demonstrated that combining neural networks with genetic algorithms can improve the accuracy of stock market investment predictions. Such advancements illustrate the growing reliance on neural networks for informed decision-making in both financial and retail sectors.

In summary, the literature shows that neural networks are powerful tools for predicting customer behavior across various applications. Their ability to model complex relationships and learn from large datasets makes them essential for enhancing customer engagement and optimizing business strategies. As research advances, the use of neural networks will likely continue to shape the future of customer behavior prediction, offering new ways to improve customer experience and business performance.

2.3.2 Enhancing Customer Engagement, Satisfaction, and Loyalty.

The integration of neural networks for unified membership systems represents a major advancement in data management and customer engagement strategies for businesses. Customer engagement has become a key concept in marketing, with research highlighting its causes and effects ([Pansari & Kumar, 2016](https://link.springer.com/article/10.1007/s11747-016-0485-6)). Customer engagement is closely linked to loyalty programs, where co-creation is seen as a crucial part of customer engagement behavior ([Hoyer et al., 2010).](https://journals.sagepub.com/doi/10.1177/1094670510375604) The role of customer engagement in building consumer loyalty has been widely recognized, particularly in industries like tourism and hospitality ([So et al., 2014](https://journals.sagepub.com/doi/10.1177/0047287514541008)). By unifying membership systems, businesses can enhance customer engagement, leading to increased loyalty and brand advocacy.

Innovation capability and knowledge sharing play essential roles in enhancing organizational performance and competitiveness. By leveraging neural networks to consolidate membership data, businesses can gain insights into customer behaviour and preferences, fostering innovation and creativity in their offerings. Loyalty programs have been shown to enhance behavioural loyalty, with member cards and discount promos directly impacting customer loyalty ([Khairawati, 2019](https://www.ssbfnet.com/ojs/index.php/ijrbs/article/view/603)). The influence of membership programs on customer loyalty is mediated by customer satisfaction, highlighting the importance of providing services that align with customer needs ([Muhammad et al., 2021](https://www.ssbfnet.com/ojs/index.php/ijrbs/article/view/1362)).

Loyalty program membership significantly affects customer purchasing behavior, emphasizing the importance of personalized rewards and incentives in driving spending (Meyer-Waarden, 2008). Implementing a unified membership integration system allows businesses to optimize loyalty programs, encouraging desired customer behaviors more effectively. Research links customer empowerment and engagement with improved marketing performance, stressing the need for organizations to focus on customer engagement initiatives ([Mohammad, 2020](https://journals.vilniustech.lt/index.php/BTP/article/view/11617)). The mediating effect of brand community membership further strengthens the relationship between customer engagement and positive marketing outcomes.

where:

* **Promoters** are customers who rate their likelihood of recommending the brand as 9 or 10 out of 10.
* **Detractors** are customers who rate it as 0–6 out of 10.

A high NPS reflects a strong level of customer loyalty, which is often the result of effective engagement and satisfaction strategies.

Retailers are increasingly focusing on paid membership strategies to drive customer engagement and loyalty ([Xu & Meng, 2021).](https://www.hindawi.com/journals/ddns/2021/6412614/) ). Early studies on retailer membership systems primarily examined memberships’ impact on customer behavior, emphasizing the importance of understanding customer preferences and motivations. Loyalty cards in small and medium-sized enterprises (SME) have transformed marketing practices, enabling firms to leverage social media for customer relationship management ([Hutchinson et al., 2015](https://www.emerald.com/insight/content/doi/10.1108/EJM-06-2013-0321/full/html) ). The integration of technology with loyalty programs has revolutionized customer engagement strategies, challenging traditional customer relationship management (CRM) approaches in SMEs.

The relationship between customer satisfaction and loyalty program membership underscores the importance of delivering exceptional customer experiences to drive loyalty ([Filipe et al., 2017](https://www.sciencedirect.com/science/article/abs/pii/S0969698916303058?via%3Dihub)). Customers relationships with grocery stores, for instance, are influenced by store formats and loyalty programs, showing how customer satisfaction promotes loyalty. This positive effect of customer satisfaction on loyalty is especially strong among members of grocery store loyalty programs, demonstrating the impact of personalized rewards and incentives on fostering loyalty.

**2.3.3 Data Integration Challenges**

Data integration challenges in predicting customer behavior using neural networks are complex and can greatly impact the effectiveness of predictive models. These challenges stem from various factors, including data quality, data diversity, and the complexities of customer interactions across multiple platforms.

One of the main challenges in data integration is ensuring high data quality. Kazemi et al. (2015) emphasize that having accurate and reliable training, testing, and validation datasets is essential for neural networks to perform well. Poor data quality can lead to incorrect predictions, as neural networks are highly sensitive to the input data. When data is inconsistent or incomplete, it can distort the results, making it crucial for organizations to apply thorough data cleaning and preparation techniques before feeding data into neural networks.

Another significant challenge is data heterogeneity, which refers to the variety of formats and structures in data collected from different sources. Sharma and Panigrahi (2011) point out that different data mining techniques, including neural networks, often require data to be in a standardized format, which complicates integration. For example, customer data might come from multiple channels, such as online purchases, in-store transactions, and customer service interactions, each with unique formats and structures. This diversity requires a robust data integration framework that can harmonize different data sources into a single format suitable for analysis.

The constantly changing nature of customer behavior adds to the challenge of data integration. Zorić (2016) highlights the importance of predictive models that adapt to shifts in customer preferences and behaviors over time. Neural networks need to learn from new data continuously to remain accurate, which requires a flexible data integration approach that can handle real-time data updates. This adaptability is crucial for accurate predictions, especially in areas like customer churn, where preferences may change quickly due to market trends or updates in services.

organizations often use **Data Completeness** and **Data Consistency** metrics as benchmarks for quality. One common formula to assess completeness is:

This metric helps organizations determine whether they have sufficient data coverage across sources, ensuring no critical gaps that could impact model performance.

Additionally, the integration of advanced analytics tools and techniques can further complicate the data integration process. Almasan (2023) discusses the difficulties of integrating neural architectures for network traffic compression, which parallels the challenges encountered in customer behavior prediction. As businesses adopt more complex machine learning methods, the need for seamless data integration becomes increasingly critical. This includes incorporating not only transactional data but also external data, such as social media activity and market trends, which provide valuable insights into customer behavior.

In summary, data integration challenges in predicting customer behavior with neural networks are significant and require careful management. Ensuring data quality, handling data heterogeneity, adapting to dynamic customer behaviors, and integrating advanced analytical tools are all essential factors for enhancing predictive models. By addressing these challenges, businesses can effectively use neural networks to gain deeper insights into customer behavior, which can improve customer engagement and retention strategies.

**2.4 Gaps in Existing Research**

Despite the potential of neural networks to improve membership integration in loyalty programs, there are still key gaps in current research that need attention. These gaps include:

1. **Limited Application of Neural Networks for Membership Integration**

While many studies have explored neural networks for predicting customer behavior and general data analysis, few focus specifically on using neural networks to unify membership systems. Most research centers around customer behavior prediction without directly addressing how neural networks could help connect membership systems across different platforms. For instance, Kazemi et al. (2015) studied customer clustering in banking but did not explore how neural networks could be used to integrate membership systems across different industries. This gap shows a need for studies that directly connect neural networks with membership integration.

1. **Lack of Practical Frameworks for Neural Networks in Membership Systems**

Many existing studies do not provide clear frameworks or step-by-step approaches for applying neural networks to membership systems. For example, Parapuram et al. (2018) looked at neural networks for creating synthetic data, but they did not discuss how to use these methods for membership integration. Similarly, He et al. (2019) highlighted the importance of social media in loyalty programs but did not explain how neural networks could bring together different platforms into a unified membership system. This shows a need for structured frameworks that can help companies understand how to use neural networks effectively for membership integration.

1. **Limited Focus on Changing Customer Behavior**

Customer behavior is always changing, which can make it difficult for businesses to keep membership systems up-to-date. However, many studies do not fully address how neural networks could be used to adapt to these changes in customer preferences. For example, Kang et al. (2015) discussed the role of loyalty programs in customer relationships but did not explore how neural networks could track and respond to changing behaviors over time. This gap indicates a need for research on how neural networks can continuously update membership systems to reflect evolving customer needs.

1. **Underutilized Combination of Fuzzy Logic and Neural Network**

While some research, such as that by Yeh and Chang (2012), explores combining fuzzy logic with neural networks, there is little focus on how this combination could benefit membership integration. Fuzzy logic could help neural networks better understand uncertain customer preferences, making it easier to create a more personalized experience. However, this potential has not been fully explored, suggesting a valuable area for future research.

1. **Impact of Data Quality and Diversity on Neural Network Performance**

Neural networks rely on high-quality data, but many studies overlook how issues with data quality and variety affect their effectiveness in membership integration. For example, Omar and Musa (2011) discussed the importance of service quality in loyalty programs but did not examine how data quality might impact neural networks. Research is needed to understand how factors like data accuracy and consistency affect the performance of neural networks when integrating membership systems.

**Summary**  
In summary, while neural networks offer promising benefits for improving membership systems, there are several important areas that need more research. These include using neural networks specifically for membership integration, creating practical frameworks, adapting to changing customer behavior, combining neural networks with fuzzy logic, and understanding how data quality impacts performance. Addressing these gaps could help businesses better use neural networks to improve customer engagement, satisfaction, and loyalty through unified membership systems.

**2.6 Conclusion**

This literature review shows that neural networks have the potential to greatly improve membership systems in loyalty programs. Neural networks are powerful tools that can analyze complex data and find patterns, making them helpful for understanding customer behavior and personalizing experiences. However, there is limited research on using neural networks specifically to bring together different membership systems.

The review also looked at key theories, like relationship marketing and social exchange, which explain why loyalty programs are effective. These theories show that loyalty programs succeed when they keep customers satisfied and engaged. Using neural networks could make loyalty programs even better by allowing businesses to offer personalized rewards and build stronger connections with their customers.

Several gaps in current research need to be addressed to fully use neural networks in membership systems. There are few practical guides on how to apply neural networks to unify memberships, and not enough focus on how to handle changing customer behavior. Additionally, combining neural networks with fuzzy logic to manage customer preferences is not well explored. The quality and variety of data needed for neural networks also remain challenges.