

Research on the Purchase Intention of Children's Educational Products Based on Feedforward Neural Network and Factor Analysis

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Abstract: To optimize the current marketing mechanism, this paper first discusses the basic concept of children's educational products and purchase intention and then discusses the influencing factors of product purchase intention. Finally, a comprehensive research method of feedforward neural network and factor analysis is designed to study the purchase intention of children's educational products. The results show that in terms of interest, consumers pay more attention to consumer products based on the cultivation of learning interest, with the highest weight proportion of approximately 72%. It can be seen that the research method of this paper can clearly understand the research results of consumers' purchasing intention. This research not only provides a reference for promoting the sales of children's educational products but also makes a contribution to market development.

Keywords: Sales mechanism, Children's education products, Purchase intention, Feedforward neural network, Factor analysis.

1. The Introduction

With the continuous development of the market and the continuous update of science and technology, research on the development of the market through scientific and technological means has become a hot spot, which can not only provide feedback results for the further development of science and technology but also provide support for the comprehensive development of the market. From the macro aspect, purchase intention can be defined as the possibility of consumers buying the commodity. From the micro aspect, that is, from the perspective of consumers, purchase intention is a psychological consultant for consumers to buy goods suitable for their own needs. It is the manifestation of consumer psychology and the prelude of consumption behavior. Therefore, research on consumers' purchase intention through scientific and technological means plays an important role in improving the sales of goods. At present, there are many studies on this phenomenon.

Kim et al. (2020) pointed out that the consumption of commodities has become increasingly an indispensable part of people's lives, and the practicality and beauty of commodities continue to attract consumers' purchase desire. Under the general environment of the opening of the two-child policy, the number of children in China is increasing. With the development of The Times, people's living standards are getting higher and higher, and the idea of pursuing a higher quality of life is becoming increasingly stronger. Faced with such a market and social environment, designers not only need to meet the practicality and aesthetics of products but also need to integrate the principles of design psychology into product design so that the designed products can be people-oriented and more in line with modern people's pursuit of aesthetic value for products [1]. Wang and Fang (2022) pointed out that improving the personal credit scoring system is the key to promoting the development of personal consumer credit business, which requires the adoption of

appropriate personal credit methods and the establishment of a credit evaluation model adapted to the current stage of social development. Therefore, researchers established a personal credit scoring index system on the basis of personal credit scoring methods and introduced a multilayer feedforward neural network to construct a personal credit scoring model [2]. Zhao et al. (2021) pointed out that to improve the learning efficiency of the weight of a multilayer feedforward neural network, a new learning algorithm was proposed by introducing the variable scale method. Theoretically, the new algorithm not only has all the advantages of the variation-degree optimization method but also plays the same role as the momentum term and the correction term in the kick-out learning algorithm and at the same time overcomes the difficulty of proper selection of one coefficient and the correction term coefficient [3]. Sahoo and Ghose (2022) proposed an adaptive feed-forward neural network structure design algorithm to solve the problem that most feed-forward neural network structure design algorithms adopt a greedy search strategy and are prone to fall into a local optimal structure. In the process of network training, the algorithm adopts an adaptive optimization strategy to merge and split hidden nodes to achieve the purpose of designing the optimal neural network structure [4]. In summary, the demand for children's products in current society is increasing, so an increasing number of types of children's products are emerging, and the resulting sales difficulties of children's products have emerged. Therefore, it is necessary to study consumers' purchase intention through scientific and technological means to improve the sales of children's products. As one of the advanced scientific and technological means, feedforward neural networks play an important role in improving the sales of children's products in the future by studying the purchase intention of consumers.

In summary, this paper first discusses children's educational products and the influencing factors of their purchase intention, then designs a comprehensive research

method of feedforward neural network and factor analysis, and finally studies the purchase intention of children's educational products based on the comprehensive method of design. The research in this paper not only provides a reference for the promotion of product sales but also makes a contribution to the optimization of product marketing methods.

2. Factors Influencing the Purchase Intention of Children's Educational Products

2.1. Basic Theory

1. Educational products for children

Educational products are educational concepts, educational planning and a complete set of compiled knowledge textbooks to achieve a certain goal as the content and as a commodity to sell products. Children's educational products are sales products targeted at children aged 0-14, which take educational concepts, educational planning and a complete set of compiled knowledge textbooks to achieve a certain goal [5].

2. Purchase intention

From a macro perspective, purchase intention can be defined as the possibility of consumers buying this kind of commodity. From the micro aspect, that is, from the perspective of consumers, purchase intention is a psychological consultant for consumers to buy goods suitable for their own needs. It is the manifestation of consumer psychology and the prelude of consumption behavior. Purchase intention mainly expresses the psychological activities of consumers and belongs to the category of consumer psychology. There is no necessary connection between the generation of purchase intention and the implementation of purchase behavior. The stronger the purchase intention is, the higher the probability of purchase behavior [6].

2.2. Influencing Factors of Product Purchase Intention

1. The influence of product value on purchase intention

Product value is very important for consumers; different products will have their own different values, and product price is an important indicator to measure the value of the product. Promotion, discounts, gifts and other marketing means are a variety of ways to convey product value to consumers. First, both customer perceived value and product value are equally important in influencing consumers' purchase intention [7]. Product value mainly includes functional value, experience value, social value, perceived value and other dimensions. Second, different detail designs in promotional activities have different effects on consumers' purchase intention. Merchants should choose discount methods according to consumers' preferences, and in

promotional activities, the improper use of promotional advertising language will also make consumers feel that the product value is reduced, thus affecting consumers' purchase intention. In summary, consumers' perceived value of products has a significant positive impact on consumers' purchase intention, but different product types need to combine different ways of transferring value and remain moderate. Excessive promotional information may have a negative impact on consumers' purchase intention [8].

2. The impact of product word-of-mouth on purchase intention

A word-of-mouth network is a social network composed of some people who communicate word-of-mouth and the relationships between these people. The relationship between these people is also called relationship strength, which is the power to maintain the social network between them. The strength of the relationship between each other will play a role in the effect of word of mouth on consumers. People are more likely to accept the more familiar objects, which enables the word of mouth information communicators with high relationship strength to put forward more suggestions for the receiving decision. Therefore, product word of mouth is one of the important factors affecting consumers' purchase intention [9].

3. Influencing factors of product brand on purchase intention

The concept of brand is relatively large, and the connotation is very rich, so there are many factors about the influence of product brand on consumers' purchase intention, mainly including the influence of brand content, brand packaging, brand IP, brand story and other dimensions on purchase intention. High-quality brand output has a positive guiding effect on consumers' purchase intention, and brand information needs to be deductively transmitted to consumers. Moreover, the packaging elements of a brand also exert different degrees of influence on consumers' purchase intention [10].

2.3. Design of Research Methods

1. Feedforward neural network

feedforward neural network (FNN) is a kind of artificial neural network. The feedforward neural network adopts a unidirectional multilayer structure. Each layer contains several neurons. In this kind of neural network, each neuron can receive the signal of the neuron in the previous layer and produce the output to the next layer. The 0 layer is called the input layer, the last layer is called the output layer, and the other intermediate layers are called the hidden layer. Hidden layers can be either one layer or multiple layers. There is no feedback in the whole network, and the signal propagates unidirectionally from the input layer to the output layer [11]. Figure 1 shows the basic structure and mechanism of the feedforward neural network.

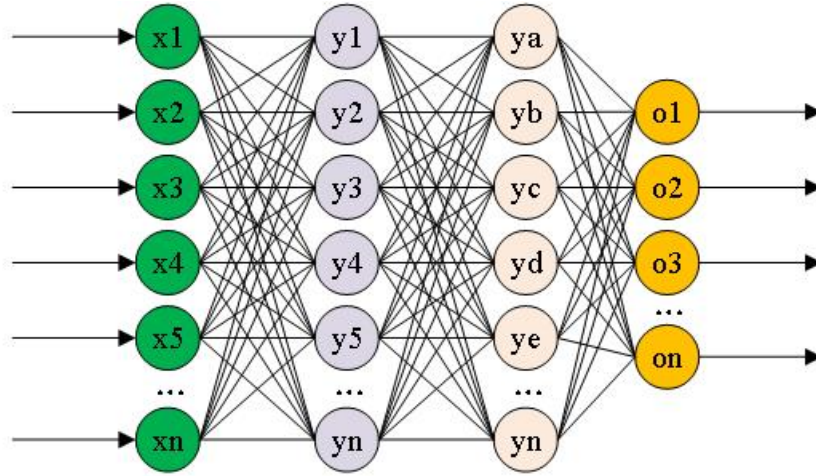


Figure 1. Feedforward neural network

As shown in Figure 1, the output layer is calculated by the following formula:

$$o(i) = f(\sum_{k=1}^K \omega(i)y(i)) \quad (1)$$

where the weight value is the calculation result of the hidden layer and is the network node. $\omega(i)$ is the position of the computing node. The formula for calculating the hidden layer is:

$$y(i) = f(\sum_{n=1}^N \bar{\omega}(i)x) \quad (2)$$

where the network node is the weight from the input layer to the hidden layer and is the calculation result of the input layer. $N\omega x$ The unipolar calculation formula of the transition function is:

$$f(x) = \frac{1}{1+e^{-x}} \quad (3)$$

However, it also has the following characteristics:(x)

$$f'(x) = f(x)[1 - f(x)] \quad (4)$$

In addition, the transfer function can also use a bipolar function according to the demand:

$$f(x) = \frac{1+e^{-x}}{1+e^x} \quad (5)$$

As mentioned above, this paper uses feedforward neural network technology to study the purchase intention of children's educational products to explore the sales status of children's educational products in the current market, without providing reference for optimizing the sales methods of children's educational products.

2. Factor analysis

Factor analysis refers to the study of statistical techniques for extracting common factors from groups of variables. Factor analysis can find hidden representative factors in many

variables. Grouping variables of the same nature into one factor can reduce the number of variables and test the hypothesis of the relationship between variables [12]. The basic formula of factor analysis is as follows:

$$X = \mu + A\bar{f} + \bar{e} \quad (6)$$

where \bar{e} is a random variable and is an unobservable random vector satisfying the

following formula: $f\bar{e}$

$$E\bar{e} = 0, E\bar{e}\bar{e}^T = \text{diag}(\sigma_1^2, \sigma_2^2, \dots, \sigma_p^2) = \Sigma \quad (7)$$

As mentioned above, there are two types of methods for factor analysis. One is exploratory factor analysis, and the other is confirmatory factor analysis [13]. This paper mainly uses a factor analysis method combined with a feedforward neural network model to study the current purchase intention of children's educational products.

3. Data Collection

The object of this paper is company X, whose main products are children's educational products. This paper mainly investigates and analyses the sales status of the company's children's educational products from 2015 to 2021 to explore the influencing factors of the purchase intention of this product. In the process of marketing products, the company mainly designed two aspects of marketing planning: the first is through interest planning, and the second is through price combined with brand planning. In terms of interest, the company mainly focuses on cultivating students' interest in learning and cultivating students' special interests. In terms of price combined with brand, the company mainly carries out sales activities based on different brands of the same type of products and different prices. In this study, the purchase intention of the company's children's educational products will be analysed based on these bases.

4. Evaluation of the Purchase Intention of Children's Educational Products

Figure 2 shows the results of this paper's analysis of the

purchasing hospitals of the products by interest.

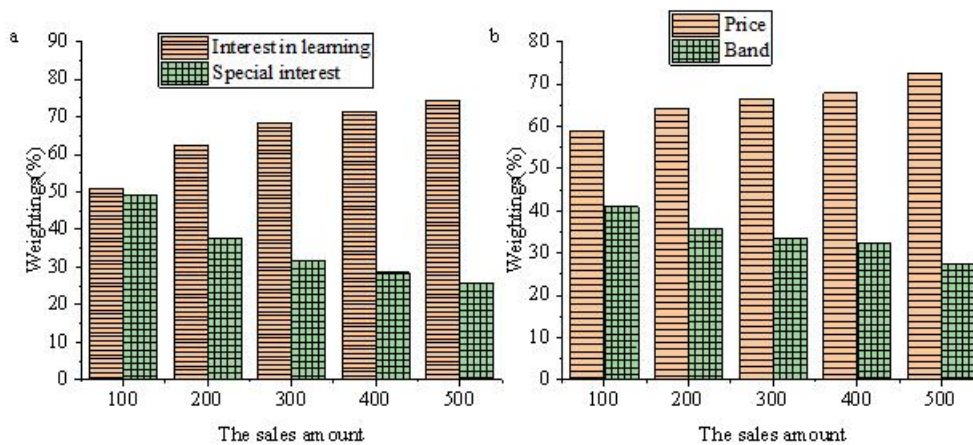


Figure 2. Evaluation of the purchase intention of children's educational products (a is interest, b is price combined with brand)

As shown in Figure 2, in terms of interest, consumers pay more attention to consumer products based on the cultivation of learning interest, with the highest weight ratio of approximately 72%. In terms of the combination of price and brand, consumers pay more attention to the price factor, with the highest weight of approximately 73%.

5. Conclusion 5

To promote the sales of children's educational products, this paper first introduces the attributes of children's educational products and then discusses the influencing factors of consumers' purchase intention. Finally, a research method of children's educational product purchase intention based on feedforward neural networks and factor analysis is designed. The research results show that, in terms of interest, consumers pay more attention to consumer products based on the cultivation of learning interest, with the highest weight ratio of approximately 72%. In terms of the combination of price and brand, consumers pay more attention to the price factor, with the highest weight ratio of approximately 73%. Although this study provides a more advanced research method, there are still few studies on its practical application, so the advantages of this research method are not fully highlighted. Therefore, in future research, we will strengthen the research on the application of this method in the century to improve the impact of this method.

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