

## Research Article

# Innovative Application of Big Data Combined with Machine Learning in Education and Training Product Marketing

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Education and training (EAT) enterprise C is taken as an example to enable EAT enterprises to choose appropriate marketing strategies according to their own characteristics to improve their competitiveness. The marketing of its EAT products is taken as the research object to analyze its marketing philosophy and marketing behavior. Initially, the marketing environment of EAT products is analyzed from macro aspects such as political environment, economic environment, and internal environment of enterprises and micro aspects such as peer competition, alternative competition, and bargaining power of buyers. Then, the main problems existing in the marketing of EAT products of enterprise C are analyzed through a questionnaire survey. Afterward, the model analyzes the effectiveness of marketing revenue and output of enterprise C. The result shows that 48% of the teachers are dissatisfied with the EAT products of enterprise C, 59% of the students dislike the training courses of enterprise C, and only 11% of the students express their willingness to continue studying the training courses of enterprise C. To solve the above problems, enterprise C can increase investment in EAT products or develop new EAT products to optimize the product marketing strategy. Additionally, it can develop agent channels rationally and adopt multichannel integration to improve the efficiency of channel strategy. Meanwhile, the new media platform can broaden marketing channels to push targeted content to users according to big data analysis results, thereby improving user experience. The marketing model provided here has referencing value as well as important theoretical and practical significance for the development of EAT enterprises.

## 1. Introduction

The release of the *Opinions on Further Reducing Students' Homework Burden and Off-campus Training Burden at the Stage of Compulsory Education* (i.e., “double reduction policy”) has triggered a huge earthquake in the education and training (EAT) industry. Consequently, EAT stocks have fallen across the board, and many training institutions have closed down, laid off, and transformed. However, industry insiders believe this impact is not harmful but gives the industry more opportunities [1]. The policy clearly points out that it is necessary to reduce the heavy workload of students' homework and off-campus training and explicitly prohibit the occupation of national legal holidays, rest days, and winter and summer vacation to organize discipline training. It attaches importance to scientific quality education and tightens discipline training. If discipline training is canceled, families will reduce this part of expenditure or

invest this part of expenditure in quality education, such as the currently popular normalized robot, maker, and programming. The rising demand for scientific quality education will increase purchase orders for scientific and EAT products. On the other hand, with the development and innovation of Internet technology in recent years, the effective development of mobile learning activities through intelligent mobile terminals has become a “catalyst” for education informatization, which plays an important complementary role in modern distance education. People's cognitive style has also undergone great changes. In the era of rapid development of digital education, online education has developed rapidly all over China, which further promotes the process of education informatization [2–4].

With the rapid development of online education, many scholars have begun to pay attention to the profit model of online education. Many developed countries, led by America, have researched traditional marketing and have formed a

perfect theoretical marketing system. Foreign countries have a more mature online education research than China because of their high market recognition and informatization [5, 6]. Foreign studies mainly focus on the profit model and marketing strategy of EAT industry. Some scholars regard the profit model of EAT industry as a way for enterprises to create and use resources, provide more value to users through profit reversal, and finally realize the profit. Briefly, the profit model refers to the company's current way of making profits and future path planning [7]. Other studies have pointed out that the online learning platform is not affected by the requirements of class time and class place, by which students can learn what they want to learn at home and play learning content repeatedly. This indicates that online learning platforms can meet most students' needs [8].

The research on the marketing of EAT products started late in China, and there is a lack of research theory on EAT products. Therefore, there are not many successful cases in the marketing of EAT products in China. Many enterprises have directly copied foreign marketing models without considering whether the models are suitable for China's environment, which lacks localization characteristics. Therefore, education enterprise C is taken as the research object, and its marketing strategy is analyzed in detail according to its marketing status and development. The research result is conducive to promoting the stable development of the EAT industry and enhancing enterprises' competitiveness. Moreover, the marketing model proposed can be used for reference by other similar enterprises, which has strong theoretical and practical significance for the development of EAT industry.

## 2. Marketing Status and Related Model

### Analysis of Online EAT Products of Enterprise C

*2.1. Profile and Marketing Environment Analysis of Enterprise C.* Enterprise C is a leading EAT company in China. Its main business includes research and development (R&D), agency, sales, and operation, and its market targets are mainly children aged 6 to 18. In order to adapt to the reform direction of the Academic Test for the Junior High School Students and Nationwide Unified Examination for Admissions to General Universities and Colleges and train the builders and successors of socialism, the company has cooperated with famous universities and groups such as Beijing Normal University, Duke University, Shanghai Jiao Tong University, Peking University, Siemens Group of Germany, and Encyclopedia Britannica Group of the United States to study the development direction of the future education system. Its main research object is STEAM (Science, Technology, Engineering, Arts, Mathematics) education and aims at breaking the boundaries between disciplines. Then, learners can solve practical problems by integrating the qualities of various disciplines, and comprehensive talents needed by the country can be cultivated [9–11]. During the academic year of 2019–2020, enterprise C participated in teaching projects in 7 schools, as shown in Figure 1.

As Figure 1 illustrates, most of the projects completed by enterprise C are provincial or municipal key institutions established by the state and have relatively sufficient funds for running. Their leaders' educational ideas will be relatively new. However, there are few such institutions in each province and city, generally only a dozen. Even there are generally no more than ten such institutions in third-tier cities. In the provincial schools, the proportion of the state-established schools will not exceed 10%. Taking Beijing as an example, there are more than 900 high schools in Beijing, among which 44 are key high schools in the city, accounting for 4% of the total institutions. By comparing ordinary high schools with municipal key high schools, markets can be divided into two types: ordinary education institutions and key educational institutions.

The educational concept of ordinary colleges and universities is relatively old. Although there is a certain demand for educational training products in ordinary colleges and universities, their educational innovation concept is relatively weak. Moreover, ordinary colleges and universities have relatively few funds for running schools and teachers with relatively less experience. Therefore, they often choose educational and training enterprises with economical prices when choosing educational and training products. However, there are many ordinary colleges and universities in the whole province. Because ordinary colleges and universities generally do not need to conduct bidding transactions directly according to the procurement bidding process of the government, the whole transaction process can be completed within one month. The payment is faster, which is beneficial for enterprises to improve training products and continuously develop new products that meet market demand. Compared with ordinary colleges and universities, the educational philosophy of key colleges and universities is very advanced. The entrance threshold of key colleges and universities is very high, the teachers are more experienced, and the students' achievements are also the best in the local area. Therefore, key colleges and universities will not be worried about students' examinations but will continue to pursue educational innovation based on the principle of ensuring the quality of education. Key colleges and universities are funded by the state, so they have sufficient funds. When purchasing EAT products, they will pay more attention to education brands and corporate reputation and carefully select several enterprises after comparison. Moreover, due to a large number of project funds in key universities' cooperative cities, they need to conduct bidding in strict accordance with the procurement bidding process of the government, so the signing process generally takes about one year.

The future development of education enterprises will be affected by their environment, so the external environment must be considered in planning and analyzing management activities, which directly impacts the strategic planning, independent positioning, and business model of enterprises [12]. Analysis of the external environment of enterprises is mainly made from the following aspects as Figure 2.

*2.1.1. Macroenvironmental Analysis.* This paper makes a specific analysis of the external macroenvironment from

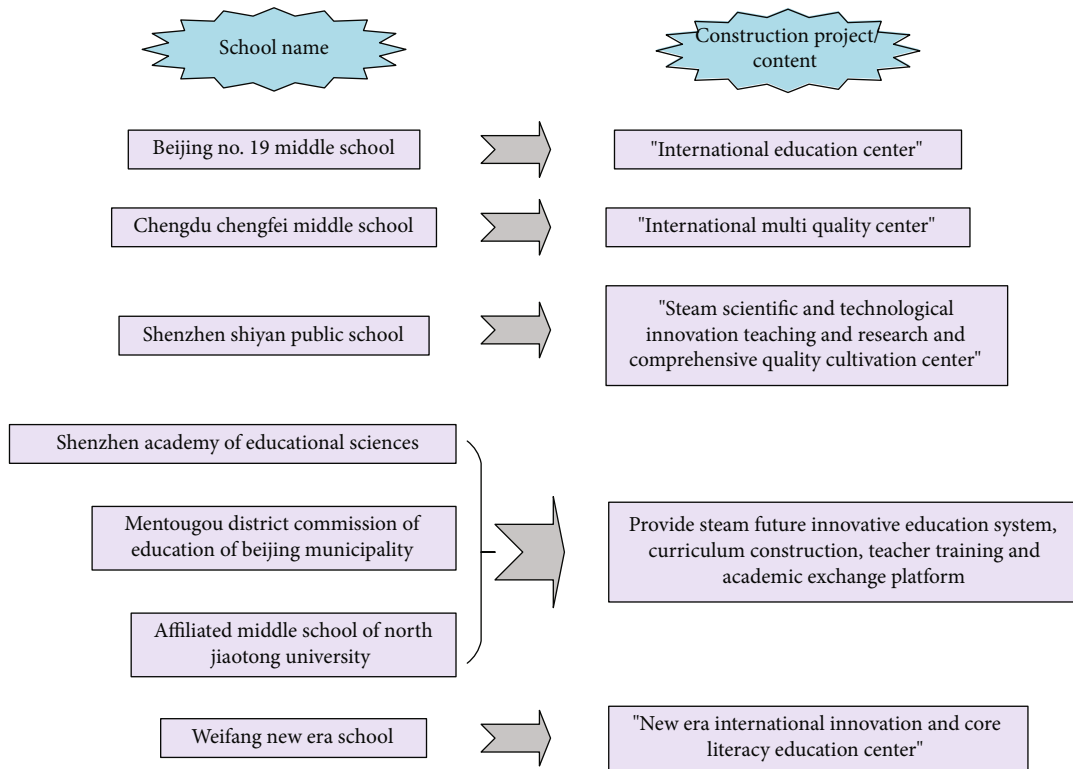


FIGURE 1: The completed project of enterprise C.

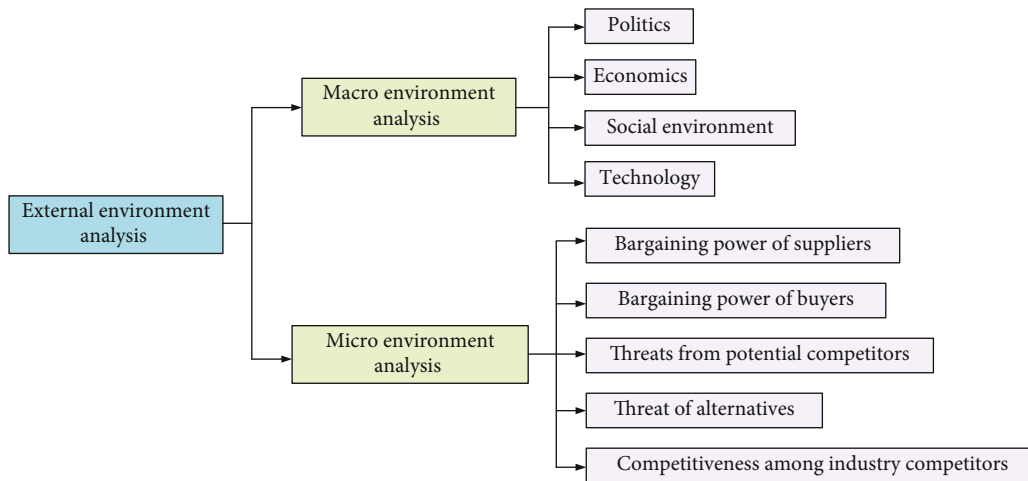


FIGURE 2: Analysis of external environment of enterprises.

four aspects: political, economic, social, environmental, and technical factors [13, 14].

The first is the analysis of the political policy environment. Relying on the *China Education Informatization* magazine of the Education Management Information Center of the Ministry of Education, C enterprise has established its education informatization research and consulting center. As one of the think tanks under the Ministry of Education, C enterprise timely understands and grasps the dynamics and information of national education policy reform.

In September 2013, the *Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020)* stressed the need to accelerate the construction of educational information infrastructure, build advanced, efficient, and practical digital education infrastructure, and strengthen the construction of network teaching resource system. It also emphasized enhancing the development and utilization of high-quality teaching resources, innovating the network teaching mode, and promoting digital campus construction.

In November 2013, the *Decision of the CPC Central Committee on Several Major Issues of Comprehensively Deepening Reform* was proposed. It is aimed at using information technology to promote educational equity, broaden lifelong learning channels, further promote the separation of management and scoring, and encourage social forces to set up education.

On September 3, 2014, the State Council issued the *Implementation Opinions on Deepening the Reform of the Examination and Enrollment System*. It proposed to adhere to people-oriented education, start the pilot reform of the examination and enrollment system from 2014, and comprehensively promote it in 2017. It is aimed at basically establishing the examination and enrollment system of modern education with Chinese characteristics by 2020 and building a lifelong learning overpass connecting and communicating all kinds of education at all levels and recognizing a variety of learning achievements.

In June 2016, the notice of the Ministry of Education on printing and distributing the *13th Five-Year Plan for Educational Informatization* pointed out the necessity to actively use mature technologies and platforms. It also stressed integrating e-learning space, innovating teaching mode, learning mode, teaching and research mode, and coconstruction and sharing mode of educational resources. Teachers and parents were encouraged to use the e-learning space for convenient communication and interaction, pay attention to the learning and growth process, and effectively guide students to use the space scientifically.

In January 2017, the notice of the State Council on the printing and distributing the *13th Five-Year Plan for the Development of National Education* proposed to promote the coconstruction and sharing of high-quality educational resources and strive to strengthen the exploration and promotion of new models of information-based education teaching and teacher teaching and research, such as “famous teacher classroom,” “famous school online classroom,” and “online open course.” It is aimed at bringing online courses into the training program and teaching plan and promoting an online open resource platform and mobile education application software research and development.

The second is economic environment analysis. From the negative growth of the world economy for the first time after World War II in 2009 to the emergence of the European economic debt problem in 2012, the uncertainty of the global economy has increased day by day. However, emerging market countries, such as China and Russia, have maintained a relatively stable and high-speed growth trend due to the development of national industrialization. China’s industrialization peaked in 2012. Since then, the country’s financial and material resources gradually turned to the service industry, thus resulting in the slow deceleration of China’s economic growth. Overall, China’s economic development provides an excellent foundation for developing the online education industry.

According to the statistics of relevant departments, the world’s average investment level in national financial education is 7%, developed countries account for about 9%, and economically underdeveloped countries account for about 4.1%. Since 1993, China has proposed to achieve the goal

of 4% of national financial education funds in the gross domestic product (GDP) in 2000. Still, only by the end of 2014, China’s national financial education funds have just exceeded 4%. Although with the rapid growth of China’s economy the amount of investment in education has gradually increased, there is no doubt that China’s education investment still lags behind the international level. Meanwhile, China has 11 companies listed abroad in recent years, including China Education Network, TAL, New Oriental, Quantong Education, and other companies overseas. The growth and recovery of the market economy have provided an impetus for the vigorous development of online education. The entry of foreign capital has provided vitality and a solid economic foundation for developing online education.

The third is the analysis of social and environmental factors. Social and environmental factors involve more dimensions than other factors, including population, income, consumption, and family. The paper mainly analyzes residents’ income and consumption. In 2013, the growth rate of online education users was only 8.6%. Since 2014, the user growth rate has continued to rise. It is expected that the number of online education users will exceed 120 million in 2016. Driven by the development speed of the Internet, the coverage of online education will increase rapidly, and schools or some official educational institutions will also speed up the construction of online education under the tide of the Internet. Due to the significant market demand for basic education, the current investment projects account for the highest proportion, accounting for 25.7% of the total investment projects. Users have strong willingness and awareness of payment for mobile EAT products, and 45.7% of users are willing to pay at the mobile end to obtain the online education services; 18.5% of users need careful consideration; 35.8% of users are not willing to pay for mobile education. With the mobile Internet development, more and more users will pay for the mobile terminal.

Fourth is the technical factors. With the development of mobile Internet technology and the advent of the era of big data, the ubiquity of mobile terminals, and the access to the Internet of things (IoT), a big data education ecosystem is being established around the production, service, development, and circulation of big data. It enables online education to make full use of the convenient function of big data. Meanwhile, artificial intelligence (AI) technology has been widely used in educational fields, such as Apple’s Siri, Microsoft’s Cortana, and iFLYTEK’s Lingxi. In particular, AI technology will make online EAT products content-based, intelligent, and personalized. Further, the expansion of virtual reality (VR), augmented reality (AR) hardware, software, and supporting wearable devices in the education system reflects seven educational functions: experience, exploration, training, correction, communication, creation, and game. The application of VR in education is mainly reflected in supporting the learning environment creation, skill training, language learning, etc. The development of modern technology and its application in the education system promote the development and realization of online education.

*2.1.2. Microenvironment Analysis.* Online education enterprise is a new type of enterprise developed based on multimedia equipment and various new information technologies. Since its establishment, the scale of the education industry has been growing, which has already had an impact on many families in China. Hence, enterprises are constantly trying to get a piece of it, which enhances the market competition of the enterprise.

Compared with junior high school and senior high school, in the experimental operation of primary school, the waste products collected by students from daily life are mainly used, so the bargaining power of curriculum suppliers in primary school is relatively low. In comparison, most of the teaching hardware used in junior and senior high school courses is provided by suppliers of related enterprises. Therefore, the bargaining power of suppliers in junior and senior high schools is strong furthermore because the group of teaching hardware is not limited to EAT institutions. Because this kind of hardware is highly professional, EAT institutions' scale is usually small. Besides, the teaching hardware needed is relatively small, and the bargaining power of EAT institutions is relatively weak compared with that of suppliers. However, if EAT institutions need more teaching hardware, their bargaining power will strengthen [15]. In order to reduce the bargaining power of suppliers, EAT enterprises shall choose not to cooperate with suppliers with a large number of orders and high technical content when purchasing teaching hardware.

Buyers of EAT products do not have strong bargaining power, mainly because the pricing initiative lies in the suppliers. Suppliers do not list price products at will but strictly control products' prices to maximize their profits. In recent years, the number of educational and training institutions has been increasing, which triggered a price war in the EAT industry. As a large-scale education brand manufacturer, in order to ensure its position, enterprise C hopes to kick out the emerging small-scale EAT enterprises through price wars [16, 17].

At present, because the development of EAT enterprises is not mature, it is impossible to control and monopolize the market, and the brand advantage has not appeared. Additionally, many business opportunities have emerged in the process of China's innovative reform in education, attracting more competitors to enter this field, which has a certain impact on the competition of the EAT industry. Enterprise C forms its main products by localizing the authorized products of foreign high-end brand EAT enterprises, which will make great profits in a short time but are not conducive to the long-term development of enterprises [18]. Competitors will follow this model and make huge profits, thus posing a serious threat to enterprise C.

The threats of the EAT products of enterprise C are mainly divided into two situations: offline products replacing online products and multimedia teaching software replacing online on-demand courses. Compared with offline products, online products lack direct communication between teachers and students, and problems such as students' lack of patience and weak binding force cannot be avoided. Such education will not improve students' learning

effect. Then, students will choose offline EAT institutions [19]. Moreover, due to the development of computer technology, teachers can transform online video materials into offline teaching materials in order to reduce the number of class hours for students to study online, which poses a threat to the interests of enterprise C. Because of the high profits of the EAT industry, the competitiveness between EAT products is relatively fierce. According to the characteristics of their own products, enterprises will compete in the market utilizing continuous innovation, price suppression, and advertising marketing. The competitive advantage of enterprise C is mainly reflected in their curriculum content, while EAT institutions in the same industry are constantly transformed from traditional offline training to online curriculum content [20–22].

## *2.2. Current Situation and Problem Analysis of Online EAT Product Marketing of C Enterprise*

*2.2.1. C Enterprise Profile.* C enterprise is an Internet company focusing on designing, developing, promoting, and operating information products in the education industry and education-related operation and maintenance consulting services. It is both a service provider and a service agent. In recent years, the company has continuously increased its R&D efforts, the core R&D technology team has been growing, and the R&D level has been continuously improved. Based on a series of self-developed key core technologies, such as big data technology (BDT), cloud computing (CC), AI, deep artificial learning, and adaptive learning (AL), the company has applied to the state and successfully obtained more than 20 independent intellectual property rights (IPRS). These IPRS has been successfully transformed and applied to its main products, K12 adaptive online intelligent learning platform, forming a series of intelligent EAT products, such as oral English easy, famous teacher classroom live broadcast, and intelligent school. As a result, it realizes a full coverage of teaching and learning scenes and complete data connection, thus actively promoting the diversified innovation of intelligent online education concepts and teaching modes. It also provides teachers and students' parents, schools, and education authorities with comprehensive, professional, and efficient integrated online education services.

*2.2.2. Analysis of Current Marketing Situation.* The online EAT products developed by C enterprise are mainly the live broadcast of oral English and famous teachers. By the end of 2019, it has served 21,266 schools and 10,177,800 teachers and students. The main users are in Guangdong and Jiangxi provinces, and a small number of users are in Jiangsu, Anhui, Fujian, and Guangxi. According to the C enterprise's annual financial report in 2018, the annual operating revenue in 2018 was 59.45 million, a yearly increase of 30.58%. The business contribution of Guangdong Province is 21.78 million, accounting for 36.64% of the annual sales. The main business is "oral English easy," the business contribution of Jiangxi Province is 6.19 million, accounting for 10.41% of the yearly sales, and the main business is basic education services (RenRen Tong business). The government and

enterprise customer branch of China Mobile Communication Co., Ltd. has contributed 4.07 million, accounting for 6.85% of the annual sales, mainly the live broadcast business of famous teachers. At present, the annual report of 2019 has not been disclosed. The annual revenue is expected to reach 90 million. The business in Guangdong Province has increased steadily, reaching about 35 million, while the business in Jiangxi Province has contributed about 23 million. The live broadcast business of famous teachers has contributed about 10 million.

At present, C enterprise's channel strategy is mainly divided into three categories. (I) Its own personnel expand channels: such type of channels is mainly aimed at high-value and high arup value customers. C enterprise's intelligent school products provide special training for senior three students. (II) For the cooperation channels of telecom operators, the company is responsible for the system design, function realization, software development, system upgrade, background operation, and maintenance of products such as "oral English easy" and "famous teacher classroom" and provides 7 \* 24-hour technical support and customer service. Telecom operators are responsible for business billing and service system. The customer directly pays the business of C enterprise to the telecom operator through the information service fee. The company and the telecom operator share it according to the proportion agreed in the agreement signed by both parties. (III) Agent cooperation channels: the company is responsible for developing products and evaluation, new media and online operation, customer service hotline, and use of question answering. The agent is responsible for taking the lead in promoting local business promotion activities, carrying out daily operation support, and encouraging school teachers to promote conversion charges.

C enterprise's promotion is mainly through free experience, which is relatively single. In early 2020, during the "Coronavirus Disease 2019 (COVID-19) epidemic," due to the impact of winter vacation and postponed school opening, C fully supported the "suspension of study" in the education departments deployed throughout the country. During the epidemic prevention and control period, the primary school and primary school teachers and students freely open the "oral English easy" platform learning function to use the full function of "oral English easily." From February to the end of March, 80,000 experience users are added nationwide.

The high-end product "smart school" has also opened free experience activities for senior two and three students to provide free training. The "smart school" app technically supports it to prepare for user transfer billing after the beginning of school.

**2.3. Main Problems in the Marketing of EAT Products.** The main issues in the marketing of EAT products are shown in Figure 3.

In the 2019-2020 school year, enterprise C participated in the teaching projects of seven schools. A questionnaire survey is conducted on these seven schools, and the research

objects are the students and teachers of Grade 2 in 7 schools. There are 30 teachers and 200 students participating in the questionnaire survey.

**2.4. Data Envelopment Analysis (DEA) Model for Analyzing the Effectiveness of Online EAT Product Marketing Investment.** The core business of enterprise C is online EAT products and services, and online EAT product research and development and marketing are the means to obtain maximum economic benefits. According to the business situation of enterprise C since its establishment in 2013, analysis is carried out on the effectiveness of its marketing investment in EAT products, and a data basis is provided for the following marketing strategy analysis.

The marketing benefit of enterprises is influenced by the marketing environment, ideas, strategies, and other factors. Other factors are assumed not to change to study the influence of marketing strategy on the marketing benefit of EAT products [23-25]. At present, the methods and means of benefit analysis and evaluation mainly include the statistical comparative analysis method, econometric method, and DEA. (I) The statistical comparative analysis method is most widely used because of the simple operation process, wide range of data selections, and easy data access. However, it cannot reflect the potential meaning of data, and the indicators are difficult to quantify. (II) The econometric method is a widely used tool to analyze direct benefits, including input-output, system dynamics, and index system analysis methods. However, it cannot reflect indirect benefits. (III) DEA is one of the applications of the linear programming model. It is a new system analysis method based on relative efficiency evaluation. It can measure the relative efficiency of operating units with the same objectives. More precisely, multi-input-output decision-making units' relative effectiveness (DEA effectiveness) is evaluated by mathematical programming (such as linear programming, multiobjective programming, conical-structured generalized optimization, semi-infinite programming, and stochastic programming) models. Thus, DEA is a good method for assessing marketing benefits. Figure 4 compares the advantages and disadvantages of different benefit evaluation methods.

According to the comparative analysis of the advantages and disadvantages in Figure 4, it can be seen that when evaluating and analyzing the marketing benefits of enterprises, DEA is an effective method that can evaluate multiple input data, especially the effectiveness of DEA, which is also called the relative effectiveness among the "decision units" of multiple outputs. Therefore, the  $C^2R$  model and  $C^2GS^2$  model of data envelopment method are used to analyze the marketing benefit of EAT products of enterprise C [26, 27].

**2.4.1. Index System Construction.** According to the characteristics of the DEA method and the marketing input-output characteristics of EAT products of enterprise C, the index system for analyzing the input effectiveness of EAT products of enterprise C is designed, as Figure 5.

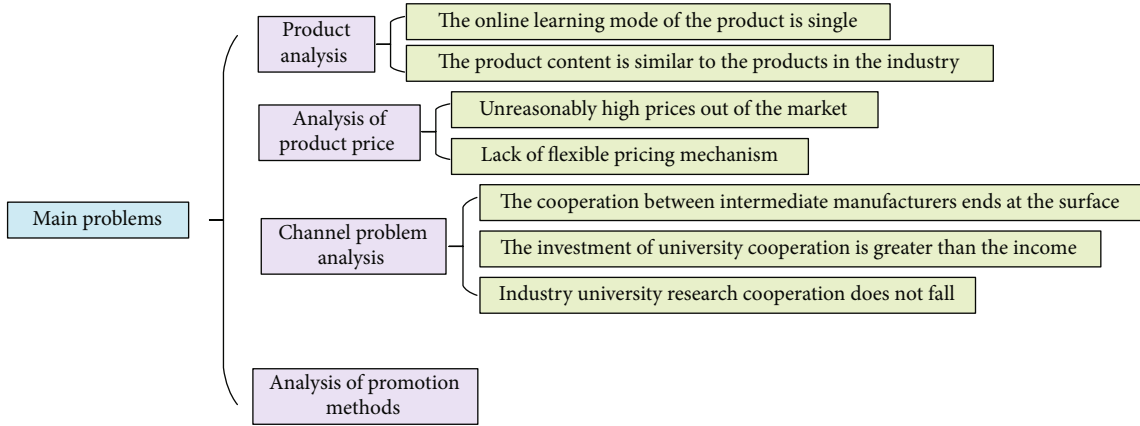


FIGURE 3: Main problems in the marketing of EAT products.

Main methods	Advantage	Inferiority
Statistical comparative analysis	The calculation process is simple and the data selection range is wide	The potential meaning of the data is difficult to reflect and the indicators are difficult to quantify
Econometric method	Direct benefits can be analyzed	Unable to reflect direct benefits
Data envelopment analysis	It can evaluate the economic benefits well	

FIGURE 4: Comparison of advantages and disadvantages of common benefits and evaluation methods.

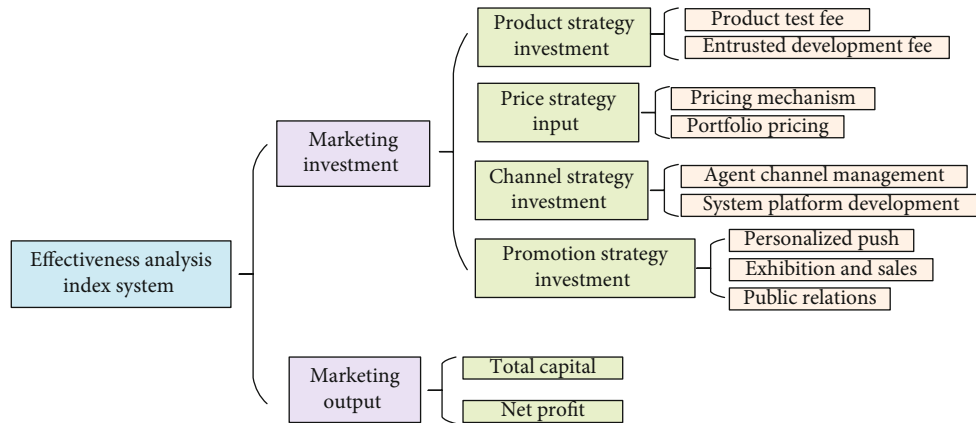


FIGURE 5: C index system for analyzing the effectiveness of marketing investment in enterprise EAT products.

2.4.2. DEA Model Construction [28–31]. First is the C<sup>2</sup>R model.

The number of decision-making units in the model is assumed to be  $n$ , and the input and output of each decision-making unit are  $m$  and  $s$ , respectively. The input weight and output weight vectors are expressed as  $V = (v_1, v_2, \dots, v_m)^T$  and  $U = (u_1, u_2, \dots, u_s)^T$ .

Equation (1) expresses the efficiency evaluation index of any decision-making unit.

$$h_j = \frac{u^T y_j}{v^T x_j} = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \quad (j = 1, 2, \dots, n). \quad (1)$$

In Equation (1),  $x_{ij}$ ,  $y_{rj}$  represent the  $i_{th}$  and  $r_{th}$  kinds of the total output of the  $j_{th}$  decision-making unit, where  $i = 1, 2, \dots, m$ ;  $j = 1, 2, \dots, n$ ;  $r = 1, 2, \dots, s$ .

The input and output vector of DMU<sub>*j*</sub> are expressed by  $x_j = (x_{1j}, x_{2j}, \dots, x_{mj})^T$  and  $y_j = (y_{1j}, y_{2j}, \dots, y_{sj})^T$ , respectively.

When evaluating the efficiency of the  $j_{0th}$  decision-making unit, the larger the  $h_{j_0}$  is, the decision-making unit can get relatively more outputs with less input.

Two weight coefficients,  $V$  and  $U$ , are set as variables, and the efficiency index of DMU<sub>*j\_0*</sub> is taken as the target. The efficiency index is specified as  $h_j \leq 1$  for DMU<sub>*j*</sub>, as a constraint condition. Then, Equation (2) can express the C<sup>2</sup>R model:

$$\begin{aligned} \max h_{j_0} &= \frac{\sum_{r=1}^s u_r y_{rj_0}}{\sum_{i=1}^m v_i x_{ij_0}} \\ \text{s.t.} \quad &\begin{cases} h_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \\ u_r \geq 0 \\ v_i \geq 0 \\ j = 1, 2, \dots, n; r = 1, 2, \dots, s; i = 1, 2, \dots, m \end{cases} \end{aligned} \quad (2)$$

Assuming that  $t = 1/v^T x_0$ ,  $w = tv$ , and  $\mu = tu$ , then the linear programming model in Equation (3) is obtained:

$$\begin{aligned} \max h_{j_0} &= \mu^T y_0 \\ \text{s.t.} \quad &\begin{cases} w^T x_j - \mu^T y_j \geq 0, j = 1, 2, \dots, n \\ w^T x_0 = 1 \\ w \geq 0, \mu \geq 0 \end{cases} \end{aligned} \quad (3)$$

From the economic and theoretical point of view, it is easier to analyze the dual model of the linear programming model. Equation (4) reflects the dual programming of Equation (3):

$$\begin{aligned} \min \theta \\ \text{s.t.} \quad &\begin{cases} \sum_{j=1}^n \lambda_j x_j \leq \theta x_0 \\ \sum_{j=1}^n \lambda_j y_j \geq y_0 \\ \lambda_j \geq 0, j = 1, 2, \dots, n \\ \theta \text{Unconstrained} \end{cases} \end{aligned} \quad (4)$$

The final model is shown in Equation (5) to reduce the workload of subsequent inspection:

$$\begin{aligned} \min \quad &\left[ \theta - \varepsilon \left( \sum_{j=1}^m s^- + \sum_{j=1}^r s^+ \right) \right] \\ \text{s.t.} \quad &\begin{cases} \sum_{j=1}^n \lambda_j x_j + s^- = \theta x_{j_0} \\ \sum_{j=1}^n \lambda_j y_j - s^+ = y_{j_0} \\ \lambda_j \geq 0, s^+ \geq 0, s^- \geq 0 \end{cases} \end{aligned} \quad (5)$$

The optimal solution of linear programming is assumed as  $h_{j_0}^*$ . The optimal solution of dual programming is represented by  $\theta^*$ , and there is

$$h_{j_0}^* = \theta^*. \quad (6)$$

If the optimal solution of linear programming or dual programming is 1, it is weak DEA efficient, and if the linear programming or dual programming satisfies the following equations, respectively,

$$w^* > 0, \mu^* > 0 \text{ and } h_{j_0}^* = 1, \quad (7)$$

$$\theta^* = 1 \text{ and } s^{*-} = 0, s^{*+} = 0. \quad (8)$$

The parameter DMU<sub>*j\_0*</sub> is valid for DEA.

Second is the C<sup>2</sup>R model and its validity analysis.

The C<sup>2</sup>R model is implemented by multiplying the effectiveness of technology and scale, so it can be called the comprehensive effectiveness of technology and scale. If parameter  $\lambda_j^*$  ( $j = 1, 2, \dots, n$ ) makes parameter  $\sum \lambda_j^*$  greater than 1, the scale return will gradually decrease. If it is less than 1, the scale return will increase progressively.

Third is C<sup>2</sup>GS<sup>2</sup> and technical effectiveness analysis.

Equation (9) signifies the C<sup>2</sup>GS<sup>2</sup> model.

$$\begin{aligned} \min \quad &\left[ \theta - \varepsilon \left( \sum_{j=1}^m s^- + \sum_{j=1}^r s^+ \right) \right] \\ \text{s.t.} \quad &\begin{cases} \sum_{j=1}^n \lambda_j x_j + s^- = \theta x_{j_0} \\ \sum_{j=1}^n \lambda_j y_j - s^+ = y_{j_0} \\ \sum_{j=1}^n \lambda_j = 1 \\ \lambda_j \geq 0, s^+ \geq 0, s^- \geq 0 \end{cases} \end{aligned} \quad (9)$$

When the output reaches a fixed value and the input cannot be reduced, it is called technical effectiveness. Namely, the C<sup>2</sup>GS<sup>2</sup> model analyzes technical effectiveness, but scale effectiveness is not applicable. Therefore, combining the C<sup>2</sup>R model with the C<sup>2</sup>GS<sup>2</sup> model can discuss the



scale effectiveness and technical effectiveness of the same group of decision-making units.

### 3. Results of Marketing Environment Analysis and Marketing Strategy Suggestions for Enterprise C

*3.1. Results of Marketing Environment Analysis.* Figure 6 presents the business data of enterprise C in recent years.

Figure 6 shows that during the development process, enterprise C has invested more in product marketing and expanding market share, and its competitiveness in the market has been continuously improved, so the total capital of the company has also shown a rising trend. The company's total profit is also constantly improving. In 2016, the enterprise's development speed started accelerating, and the company's total profit has also increased greatly. This shows that enterprise C can maximize the profit margin of products under the condition of cost control so as to obtain the maximum economic benefits.

*3.1.1. Macroenvironmental Analysis Results.* In 2013, the growth rate of users of EAT products in China was 8.6%. Since 2014, the number of users of EAT products began to increase continuously and exceeded 120 million in 2016. Moreover, users of EAT products are also willing to pay for mobile EAT products, as shown in Figure 7.

With the development of computer technology, in order to enable EAT institutions to utilize the convenience function of big data further, an educational ecosystem of big data has been established around various functions of big data. Artificial intelligence technologies, such as Huawei's Xiaoyi and Apple's Siri, have also been widely used in the field of EAT. The personalized and intelligent development of EAT products has been realized.

*3.1.2. Microenvironmental Analysis Results.* The "Five Forces" analysis method proposed by Porter is used to analyze the product competition pattern of enterprise C. Figure 8 displays the results.

Figure 8 analyzes the competitive pattern of enterprise C from five aspects and scores the degree of each item by using numbers 1-5. Results show that the attractiveness of primary school, junior high school, and senior high school is not the same, and their individual characteristics are quite different. Therefore, in the development process, according to its own characteristics, potential, and development scale, it is necessary to select the submarket suitable for its own development.

*3.2. DEA Model Calculation Results.* This section analyzes the marketing effectiveness of enterprise C's EAT products based on the marketing input and output data from 2017 to 2021. Figure 9 specifies the data results.

C1-C12 in Figure 9, respectively, represent pricing mechanism, DMU, public relations, personalized push, exhibition and sales, agent channel management, product testing fee, commissioned development fee, combined pricing, system platform development, advertising planning, and total

capital. Figure 10 shows the net profit of enterprise C from 2017 to 2021.

$C^2R$  model is used to calculate the marketing effectiveness of EAT products of enterprise C. Figure 11 shows the results.

Figure 11 indicates that from 2017 to 2021, the comprehensive, effective coefficients of marketing technology and scale of enterprise CEAT products are all less than 1, which are all non-DEA effective. However, the comprehensive, effective coefficient is increasing year by year. According to the calculation results in 2020, this section makes a specific analysis of its technical and scale effectiveness, and the analysis process in other years is similar.

*3.2.1. Technical Effectiveness Analysis.*  $C^2GS^2$  model is used to analyze the marketing decision-making unit's technical effectiveness of enterprise C's EAT products in 2020. Equation (10) displays how the results are obtained.

$$\theta = 1, \quad (10)$$

$$S11 = S12 = S13 = S14 = S21 = S22 = 0.$$

The results show that enterprise C's marketing of EAT products is technically effective in 2020. That is to say, the allocation of marketing resources of enterprise C in 2020 is more efficient than that in 2017-2019.

*3.2.2. Scale Effectiveness Analysis.* Taking the marketing situation of EAT products of enterprise C in 2020 as an example, Equation (11) can be formed

$$\theta^* = 0.6183. \quad (11)$$

This time, non-DEA elements are effective in investing in EAT products of enterprise C in 2020. Equation (10) presents that the marketing of EAT products of enterprise C in 2020 is technically effective, so it means that the marketing investment of EAT products of enterprise C in 2020 is not effective in scale, where Equation (12) is obtained.

$$\sum \lambda_j^* = 0.584 < 1. \quad (12)$$

From Equation (12), it can be concluded that the scale income is growing, which indicates that the scale of resources invested in the marketing of EAT products of enterprise C is relatively large in 2020, showing a growing trend.

#### 3.3. Suggestions on Marketing Strategy of EAT Products of Enterprise C

*3.3.1. The Results of the Questionnaire Survey.* Through the questionnaire survey in Section 2.2, Figure 12 shows the satisfaction degree of 7 schools to curriculums of enterprise C.

From the questionnaire survey results, a conclusion can be drawn that 48% of teachers are dissatisfied with the EAT products of enterprise C, and only 9% of teachers are very satisfied with the EAT products of enterprise C. 59% of the students did not like the training courses of enterprise C, accounting for more than half of the total number. Only

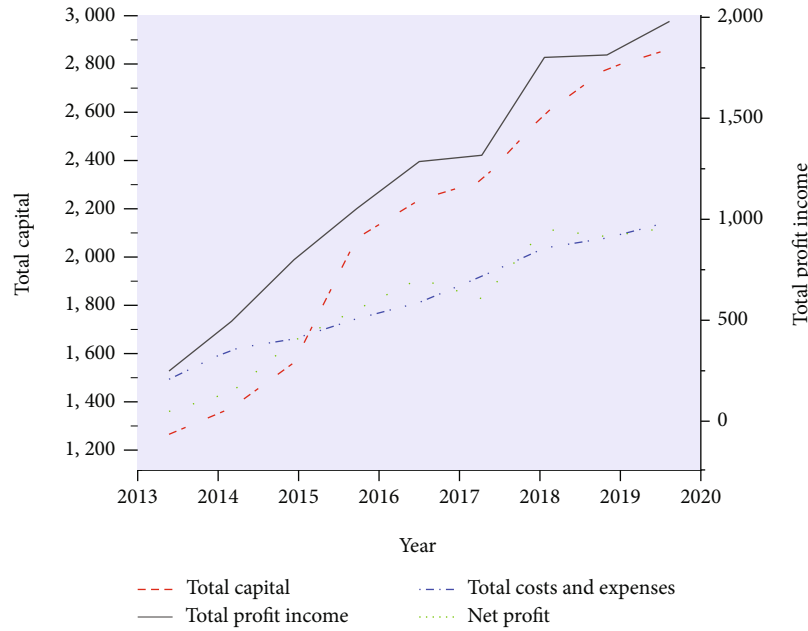


FIGURE 6: Main annual business data of enterprise C.

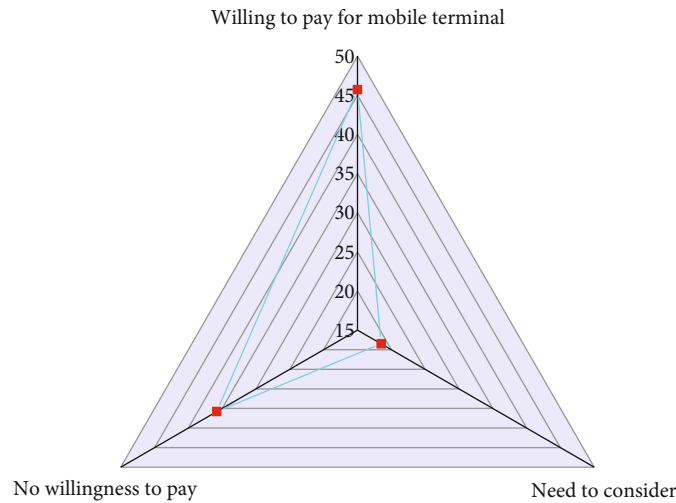


FIGURE 7: Users' willingness to pay for mobile products.

11% of the students expressed their willingness to continue studying the curriculums of enterprise C. From the data in Figure 12, both teachers and students are shown to have very low recognition of satisfaction to EAT products of enterprise C. Therefore, in order to improve user experience, it is necessary to optimize the marketing strategy of EAT products of enterprise C.

**3.3.2. Suggestions on the Marketing Strategy of EAT Products.** The questionnaire survey results and the model analysis results in Section 3.1 indicate that the marketing of EAT products of enterprise C has made some achievements. However, some problems still need to be solved urgently,

such as single teaching mode, difficulty in distinguishing EAT products from products of the same type in the market, and lack of innovation. Therefore, the corresponding marketing strategy and implementation guarantee are put forward for the marketing of EAT products of enterprise C, aiming at correcting the existing problems of enterprise C, as shown in Figures 13 and 14.

**3.3.3. Product Strategy Reconstruction.** First, there is a need to increase investment in product R&D. Company C has established a strong domestic scientific research team based on the policy support of the education management information center of the Ministry of Education. The cooperation

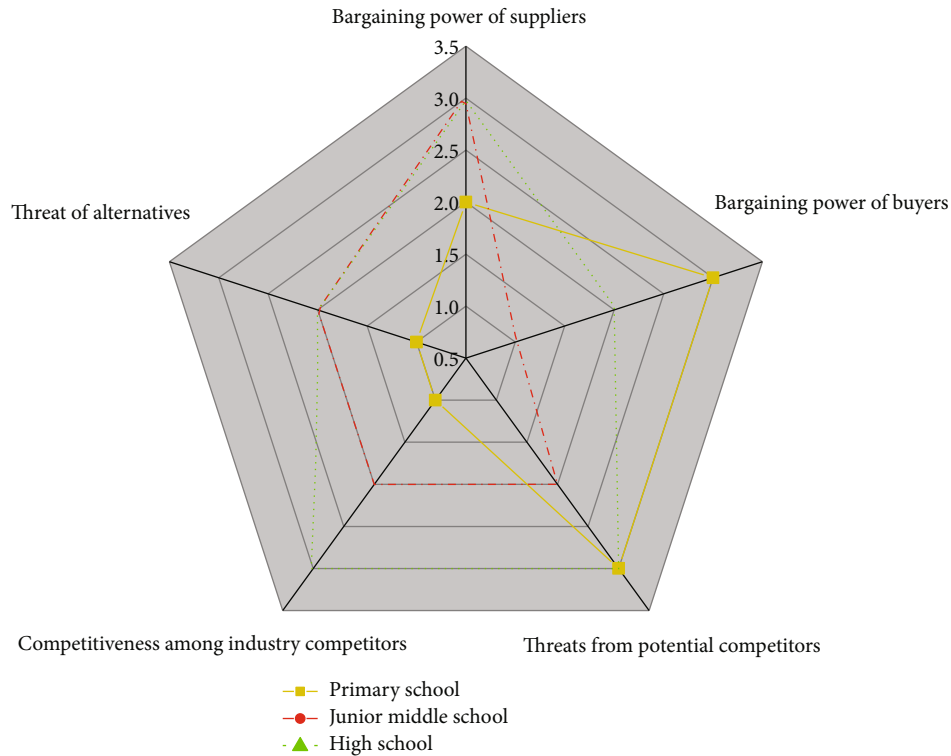


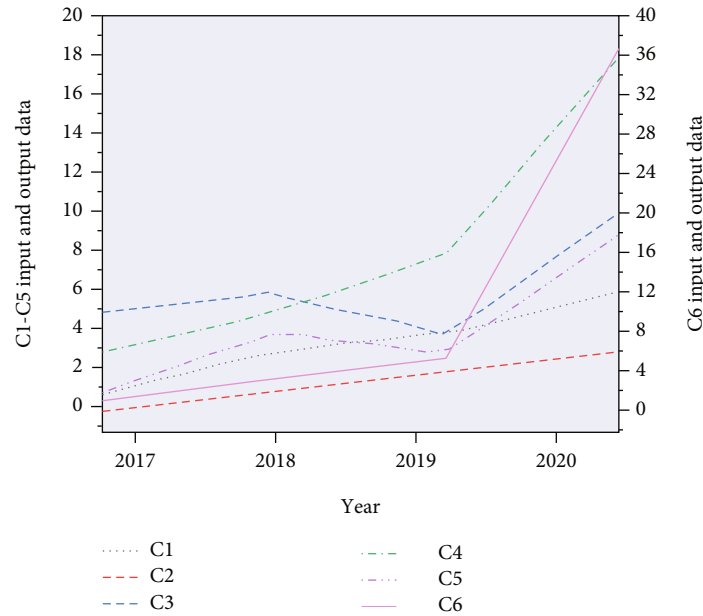
FIGURE 8: Schematic diagram of five forces model.

involves the Beijing Normal University, East China Normal University, South China Normal University, and Shaanxi Normal University. Such cooperation promotes enterprise C to have domestic advanced product development mode and new product R&D capability. For example, the career planning course jointly developed by C enterprise and the Psychology Department of Beijing Normal University is the first set of teaching materials approved by the National Teaching Materials Committee and officially published by *East China Normal University Press* under the new policy reform for the college entrance examination. It has fired up the first career planning course in the domestic basic education market with wide recognition. However, at the same time, it faces a large number of domestic peer competition, and competitors are good at product copying and imitating. Moreover, their competitors might cost much lower because the opportunistic only have to make a slight change in the product's form or function to avoid the sanctions of laws, such as patent law. Additionally, the career planning course developed by C enterprise has been promoted by Yuan Bo Education Group through PPT. Company C has no choice but to investigate its legal responsibility for infringing IPRS.

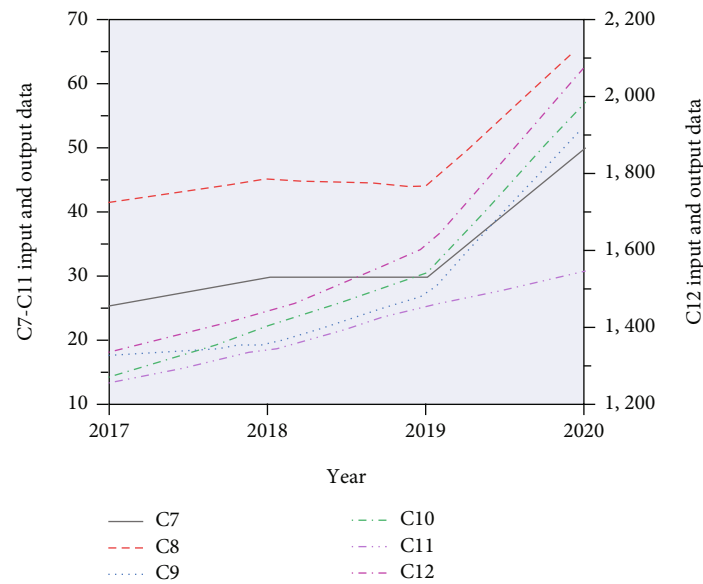
Based on the above situation, C enterprise needs to give full play to its unique advantages, gather up the strength of the R&D team, and increase the technical talents of its specialty. At the same time, combined with scientific research experts, it should split the product into several modules, complete them in different units, and finally integrate them to develop online EAT products that are not easy to be imitated. Doing so can increase the imitation cost of its compet-

itors, make its competitors automatically flinch, and provide a better guarantee for the R&D and innovation of C enterprise's online EAT products. Further, there is a need for C enterprise to make a full and professional market investigation and demand analysis. Such efforts can help improve online EAT products R&D. Meanwhile, it should optimize the products' core functions and determine the marketable product design through trial sales and market feedback. Then, the products should be improved according to the feedback and finally put into the market.

Secondly, according to C enterprise's online education course product design, it is imperative to closely follow the direction of national education reform, implement the general education reform goal of building morality, and cultivate talents, particularly innovative talents. Meanwhile, it should take the "two bases and one reference" proposed in the *New College Entrance Examination and New High School Entrance Examination* as the basic reference basis and highlight the requirements and characteristics of comprehensive quality evaluation. Moreover, C enterprise should employ the problem-based learning (PBL) model and pivot the curriculum towards students' independent exploration. At the same time, curriculum designs should be diversified by online courses (such as video courses, electronic resources, teaching materials, and teaching PPT) and offline activities and students' experiments. As a result, an integrated curriculum design can be formed through experimental packages and teaching aids, which highlight the differences between C enterprise's online products and other peer companies. Subsequently, the products for the first-class market should



(a)



(b)

FIGURE 9: Marketing input and output data of EAT products of enterprise C: (a) C1-C6; (b) C7-C12.

be designed into an integrated closed loop. Specifically, once students enter high school, their performance will be evaluated, and they will be encouraged to select courses, such as the innovative targeted courses of STEAM courses. The results will generate a comprehensive quality evaluation system that is recorded in students' files and finally pushed to the independent enrolment platform of the university. First-class market demonstration key schools pursue such complete closed-loop curriculum resources and services. However, products need to be classified and combined according to their functionality for the second-class market. According to their own situation, ordinary high schools can

choose individual evaluation to purchase services, curriculum resources, teacher class hours of a course, products of a single module, and any module that can be combined. These ordinary schools can be given more free choices in the second-class market to decompose the pressure on funds.

**3.3.4. Price Strategy Reconstruction.** First, improve the pricing mechanism and be close to the characteristics of market purchasing power. Company C's online EAT products adopt the cost pricing method because C enterprise's main products are educational resources introduced from foreign scientific research institutions and universities. At the same

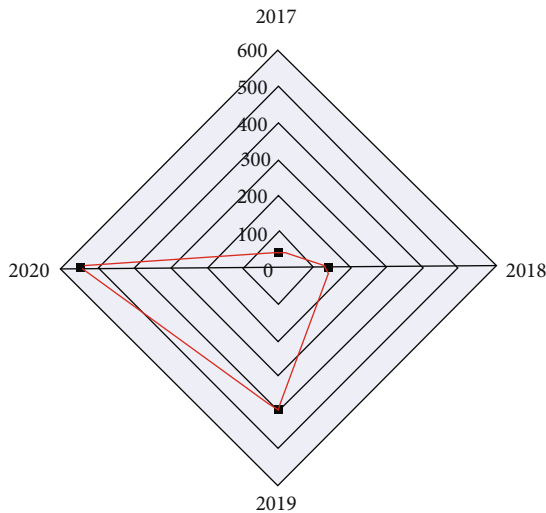


FIGURE 10: Net profit of enterprise C from 2017 to 2021.

time, it has translated the learning products introduced by foreign institutions, obtained publishing authorization, edited corresponding teaching materials, teaching aids, and other teaching materials, and developed a curriculum and textbook model suitable for normal teaching in China. In this way, compared with the product structure of its peers, C enterprise is bound to invest more funds and personnel in its products, which increases the R&D cost of its products and loses its price advantage. Company C's online EAT products adopt the cost-based pricing method. Because it introduces EAT products and makes R&D investment in the localization transformation of products, its product price is generally higher than that of similar EAT products in the domestic market, so it is in a disadvantageous position in price competition. Therefore, C enterprise should flexibly adjust the pricing mechanism according to the market demand, implement product price discrimination pricing, and shorten the gap between product portfolio pricing and market psychological pricing and demand.

Therefore, C enterprise can adopt the secondary price discrimination strategy, consider the continuous purchase of students as much as possible with competitors of similar products, and enhance the value of the product itself at the same time to improve the competitiveness of the product in the market and the marketing benefits.

Second, introduce product portfolio pricing to increase the flexibility of customer selection.

The company's products feature both online courses and offline experimental packages. The company should build explicit experimental venues for the school simultaneously. In the face of different users, it can carry out reasonable product classification and positioning. Students can be recommended with a single online course, while the school provides relevant services to buyers. On the premise of clarifying the school's needs, Company C should match with a three-dimensional product portfolio to improve complete serviceability to produce high customer value and stickiness. For the first-class market, it is suitable to push the highest level of the product portfolio, namely, the product structure

of the complete system. The purchase and construction of all modules are completed by one bidding to maximize the profit. For the second-class market, it is generally acceptable to push modular products, price them by category, and charge according to the price of a single product. Such marketing is equivalent to a form installment payment, which reduces the huge financial budget pressure of one-time purchases in the second-class market.

#### 3.4. Architecture Design of Crowd Portrait Analysis System.

With business development, the amount of online education user data of C enterprise has increased sharply, and the labels have become more complex and sophisticated. Then, this section provides a centralized and standard platform service to manage better and use these labels, provides a standardized and intelligent docking platform for label developers, and provides users with a simple and easy-to-use interface. It is convenient to create, analyze, and calculate the population in real time. Meanwhile, it supports enterprise C's precision marketing, specific population mining, statistics, recommendation, advertising, and data analysis.

**3.4.1. System Technical Architecture Design.** The system has formulated a unified access protocol to standardize the management of the tags accessed by each business line by specifying the person in charge of the label, unique name, update cycle, connected hive library table, and record links introduced by the tag. As a result, it can create a standardized and intelligent platform-level product.

The whole system consists of a data storage layer, data computing layer, business logic layer, and application interface layer. The composition of each layer is conveyed in Figure 15.

The data storage layer can store user data and access tag data in a distributed manner. MySQL mainly stores system data, user authority data, and the association of external data. A large amount of data that the system needs to process depends on other systems or data sources. The data processing layer uses Java and Elastic Search framework to realize label retrieval. Offline batch processing uses Spark for calculation, and real-time labels use Storm for real-time calculation. The front-end user interface is developed using the React framework in the business logic layer, which exchanges data with the middle layer through the interface. The back-end uses the Spring Model View Controller (MVC) framework to exchange the underlying data and the middle layer through the interface. The user-visible web UI processes rule through Structured Query Language (SQL) like transformation. Restful can receive and parse Hypertext Transfer Protocol (HTTP) requests. The label application at the top layer represents the system functions, which can be used for fine operation and reduce the cost of promotion and publicity. It can be used to analyze the portraits of users in various dimensions, change trends, and help make decisions. The data analysis results give an insight into the changes in advance to do reasonable risk management. For some people with specific behaviors or labels, personalized services can be made to improve the user experience.

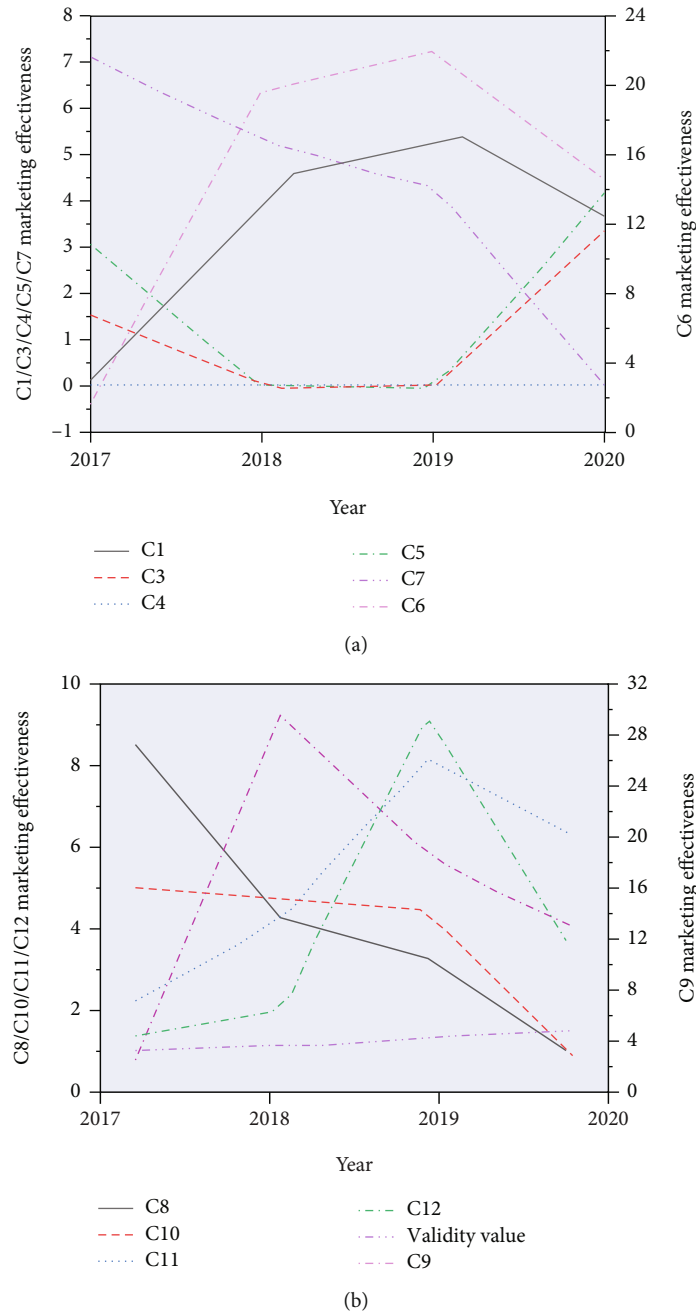


FIGURE 11: Effectiveness calculation results of enterprise EAT products of enterprise C: (a) C1-C7; (b) C8-C12.

3.4.2. *System Function Module Design.* Figure 16 sorts and summarizes the system’s requirements and the functional modules.

**Login module:** when users access the system for the first time, they will jump to the authentication system and log in with the company’s internal account. After that, they will access all trusted systems through this verification information. The system can identify the authentication mark to complete the single sign-on function.

**System management module:** this module manages the user’s authority and further controls the system operation through authenticated accounts, such as operating departments and cities. In addition to managing user rights, there

is also the management of third-party systems, including interface call and authorization.

Crowd creation module can be realized through label filtering, rule formulating, and crowd identity (ID) uploading. For junior users, it can be created through the template.

The crowd analysis module can realize the multidimensional composition analysis and trend analysis of the crowd and show the characteristics of a single user.

The crowd calculation module can generate new crowds through the intersection, union, difference, and other operating rules and realizes scene-based crowd calculation.

The label management module includes several submodules of label registration, label storage, and label query to

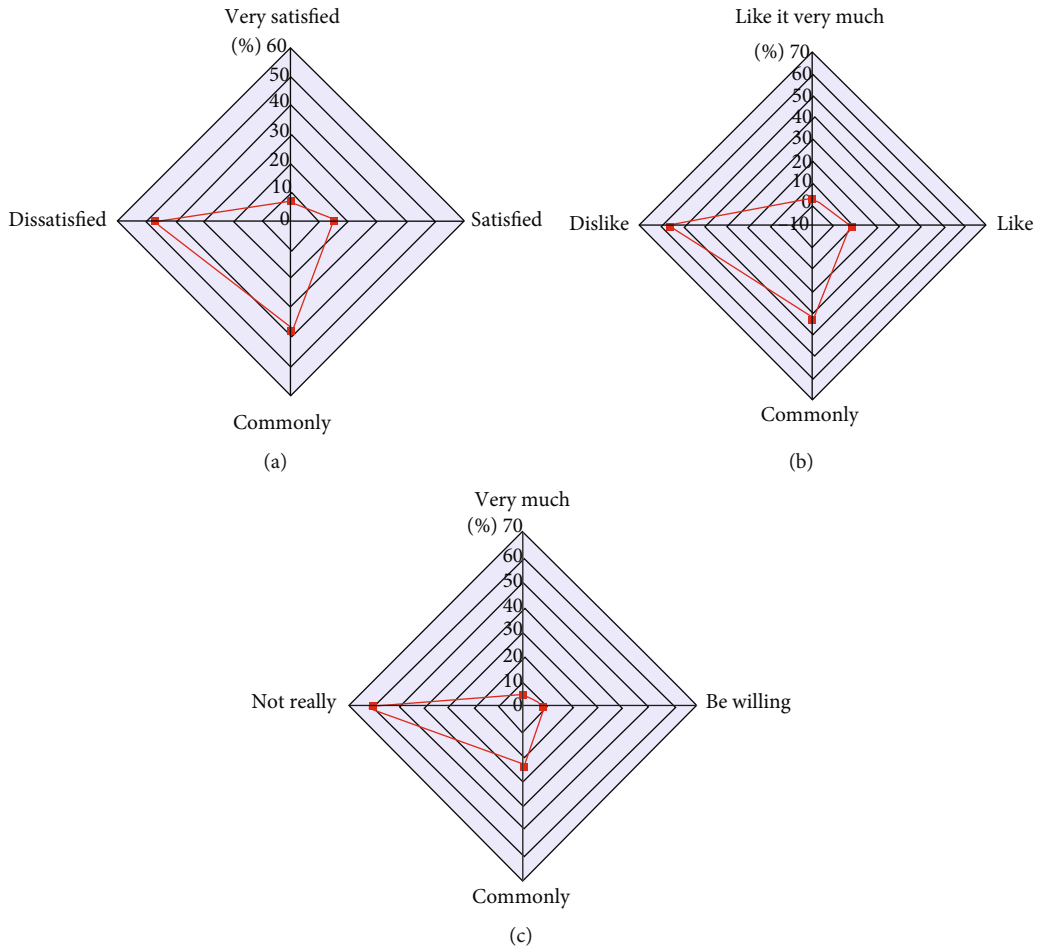


FIGURE 12: Questionnaire survey results: (a) teachers' satisfaction with products; (b) how much students like the course; (c) the degree to which students are willing to continue using the products.

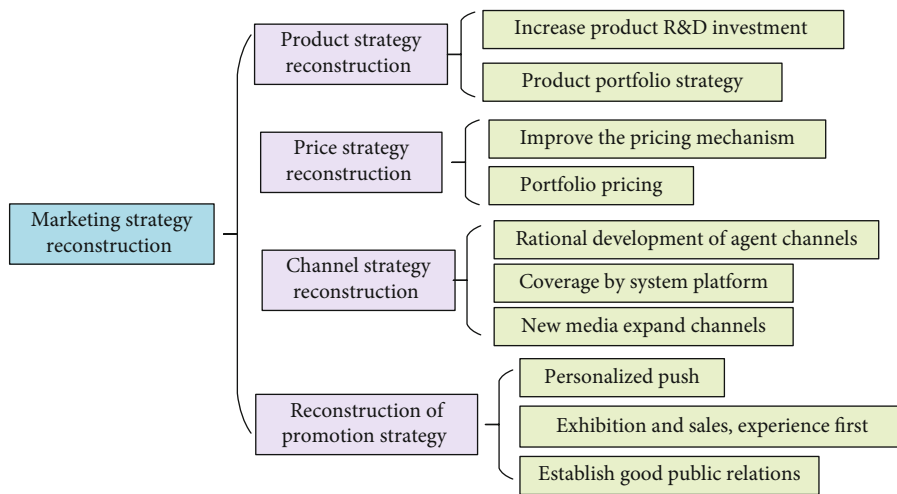


FIGURE 13: Marketing strategy of EAT products of enterprise C.

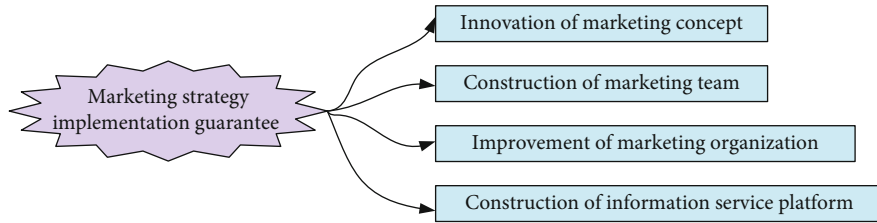


FIGURE 14: Implementing guarantee of marketing strategy for EAT products of enterprise C.

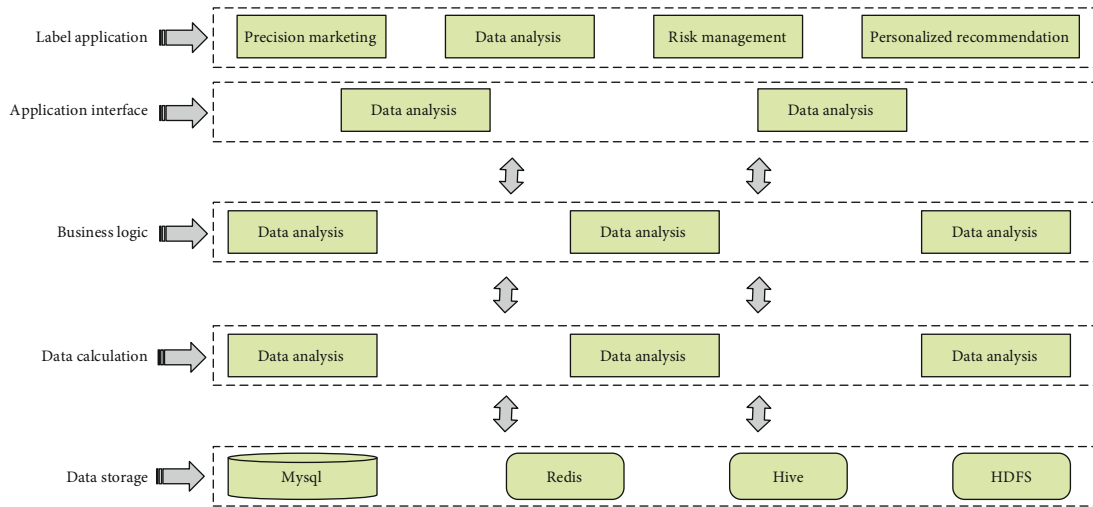


FIGURE 15: System technical architecture diagram.

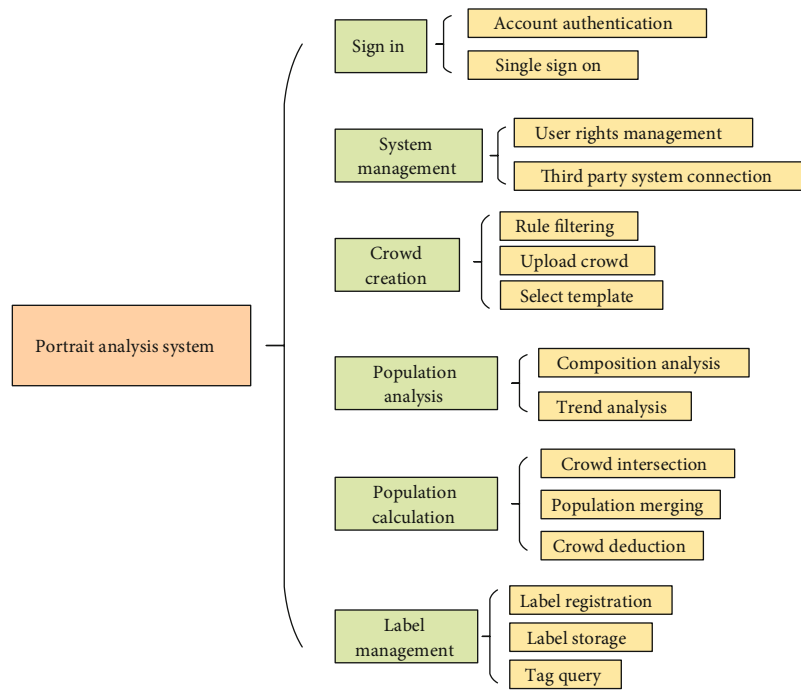


FIGURE 16: System function module diagram.



realize the functions of accessing the label, distributed storage, and full-text retrieval of the label development team.

#### 4. Conclusion

With the rapid development of computer technology, online EAT has become a mainstream trend in today's world education development. However, due to the low threshold of EAT institutions, more and more commercial capital is entering this industry, which led to increasingly fierce competition among industries. Enterprises are required to choose their own product marketing strategies according to their own characteristics and future development. The EAT products of enterprise C are taken as the research object. Primarily, the external macroenvironment and microcompetitive environment of the EAT products of enterprise C are analyzed in detail. Then, through a questionnaire survey on the teaching projects of seven schools in which enterprise C participated in the academic year from 2019 to 2020, the satisfaction of teachers and students of the school with the EAT products of enterprise C is obtained. Additionally, the model analysis is made on the income and output effectiveness of the EAT products of enterprise C according to their financial revenue from 2017 to 2020. According to the model calculation, the effective investment of enterprise C is mainly reflected in system platform development, product testing fees, personalized push, and so on. According to the results of the effectiveness analysis, the product marketing strategy of enterprise C is optimized. It is found that, in the subsequent development process, enterprises can enhance their competitiveness by strengthening the brand building of enterprise EAT products, combining online sales with offline sales, improving the speed of new product research and development, optimizing personnel organization structure, and cooperating with other EAT enterprises.

#### Data Availability

The labeled dataset used to support the findings of this study are available from the corresponding author upon request.

#### Conflicts of Interest

The author declares no competing interests.

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