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Study on Consumer Behaviors and Market Conditions of AI Skincare Industry from Digital Health Economics Perspective

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Abstract

With the combination of digital technology and dermatology-focused consumer cosmetics, a new group of innovative AI-powered skincare products has appeared. Based on the theory of digital health economics, this paper systematically examines the current market environment and consumer behaviour that promotes the use of algorithmic skincare diagnosis and personalised formulations. The goal of the new economy for health is to increase the efficiency of health-care resources, commercialize medical data and achieve value-oriented outcomes. Research on the impact of artificial intelligence in the skincare industry has changed the model for subjective aesthetic needs to a data-driven, medical-grade adjustment. In addition, a well-known technology acceptance model will be used to understand how consumers are motivated, and their feelings of trust and worry about privacy will also be investigated. Based on the above analysis, although optimisation of algorithms can stimulate demand from consumers, the continuous expansion of the market requires the construction of a strong ethical system and more open algorithms. In short, this paper offers an all-weather guide for all parties involved in the convergence of algorithmic technology and individual skin health.

Keywords

Artificial Intelligence, Digital Health Economics, Skincare Industry, Consumer Behavior, Technology Acceptance, Dermatology.

1. Introduction

The entire global industry of personal care and beauty is changing now, and people want more personalised, science-based beauty and wellness products. In the past, the demand for skincare products has mainly been driven by the self-proclaimed advantages of brands, fame, etc., and experimentation. With the increasing demand for health and technology in modern life around the world, the division between cosmetics and dermatology has become less and less obvious. Now, people do not want simple improvements; they want particular, scientifically supported changes in their bodies. Due to a change in the expectations of the public, many companies have invested in advanced computing technologies to build a new era of intelligent care and launched the first AI-powered skincare brands.

This new-age industry is based on complex machine learning algorithms, deep neural networks and computer vision for analysis of consumer biometric data. Take a high-resolution picture of the face using a mobile phone or a smart mirror to have the AI automatically detect the severity of fine wrinkles, hyperpigmentation, dehydration, etc., in that area of the skin. Based on the above analysis, an individualised skincare plan will be dynamically generated to create custom chemical serums according to the particular biological data of the person. In short, artificial intelligence skincare is bringing professional-level dermatology assessments to the people and changing mobile phones into all-access, first-aid clinics for the public.

To explore the broad impact of the above technological change in more detail, a model of digital health economics will be employed. One such area of study in the economics of digital health is

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the distribution of medical resources and the creation of value through the digitalisation of biological information, as well as market operation efficiency. Economically speaking, the development of artificial intelligence skincare will be linked to new forms of consumption and will fall within the broader trend of digitalised healthcare. It has altered the supply chain of dermatology services, commodified facial biometric data as a high-value economic asset, and introduced new behavioural economics for how people allocate funds for preventative maintenance of their physiology.

The purpose of this paper is to conduct all-encompassing studies of the market conditions and consumer behavior in the artificial intelligence skincare industry from the standpoint of digital health economics. Based on the introduction above, Section 2 will lay out the theoretical basis and apply the principles of digital health economics to the dermatological consumer market. Section 3 introduces the current market conditions and competitive factors, and presents cutting-edge technologies and entry difficulties. Section 4 presents all kinds of reasons for people's reluctance to use new technologies and their privacy concerns. Finally, Section 5 summarizes the main results and presents some forward-looking ideas for algorithmic aesthetic medicine. Given the size of the change, many departments and schools will need to be involved in the study. Analysis of the consumption behaviour of cosmetic products can no longer be done by only applying the former two methods. Machine learning algorithms are now used to develop such new drug substances and treatments that can be delivered continuously. When a smartphone application is able to monitor the daily changes in a person's skin barrier and adjust the active ingredients in a smart-dispenser accordingly, the basic type of the transaction has changed. The product is a digital healthcare service now. Therefore, at the same time, these factors will influence the evaluation of goods by consumers and the arrangement of production by suppliers. Health economics can be applied to analyse this way to quantify the hidden data economies underlying the operation of high-end predictive models and forecast individual health management trends.

2. Theoretical Framework of Digital Health Economics in Skincare

Digital health economics reorders the old market system and, by means of data, generates value and optimises resources. Economies of scale have not been realised in the traditional healthcare and beauty sectors, and due to information asymmetry, most consumers lack the specific medical knowledge required for personalised care; as a result, they spend a considerable amount of money on general treatments that fail to meet their actual needs. Big data and health analytics can be used to process a large volume of data and extract specific patterns in biology to help address the problem described above [2]. In the context of artificial intelligence skincare, a digital health economics model believes that value is created by hyper-personalisation, thus significantly reducing the economic waste caused by trial-and-error consumption of products.

A representative feature of the economic model is high-performance medicine; it will integrate human biology and artificial intelligence to achieve high accuracy in diagnosis at a basic level [6]. With the help of many resources, AI models have learned from a large number of images of skin diseases and can now perform high-level diagnosis that is close to or even better than that of experienced dermatologists. This technology will spread medical knowledge more broadly and bring some healthcare to the people at home instead of making them go to hospitals. As a result, the artificial intelligence skincare industry has become a deep-seated economic democratization of dermatological health, significantly reducing the financial barriers to preventive skin care and early pathological detection.

However, the digital health economy view also points out the large-scale commercial value of the underlying biometric data. Consumers in this digital ecosystem are both customers of the service and primary sources of computational capital. A continuous stream of high-definition

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facial images, environmental exposure logs and genetic data from users are fed into the algorithms of large-scale technology and cosmetics enterprises. The cycle of data collection has created a high barrier to entry for algorithms, and only those with large volumes of data can produce economically feasible and accurate-in-practice products [9]. Therefore, the economic valuation of an artificial intelligence skincare enterprise is no longer based solely on its physical production capacity but rather on the speed and scale of the consumer data it can continuously acquire and analyse in a biological context. Research has shown that the economic reasons for this are primarily linked to reducing the cost of failure. Digitisation at the level of macro-health economics seeks to move the model of medical care from one that responds to illness to one of early intervention and prevention. The above applies to the process of smart cosmetics. Serious chronic skin diseases, such as severe acne vulgaris, rosacea and photodegradation, are likely to be expensive to treat and require frequent visits to the clinic, lasers and other medicines. Over a long period, artificial intelligence algorithms have been trained on vast amounts of biological data, and are now capable of identifying minute alterations in cells that may precede various diseases at a much earlier stage than traditional symptoms. Help the public become aware of possible diseases in advance, and then offer corresponding anti-aging products at an appropriate time to help reduce the occurrence of these diseases. The following reduction in the scope of work is also relatively large. Consumers are unwilling to bear the high economic cost and psychological pressure of high-end skin treatment; thus, an artificial intelligence platform can establish a stable and long-term subscription-based revenue model. The two will operate in concert to boost the economy and thus enable the current high valuations of health-technology startups in the beauty industry.

3. Market Conditions of the AI Skincare Industry

At present, the artificial intelligence skincare industry is in a high-growth phase, and many companies have been acquiring others. The three main forms of the market are intelligent diagnostic hardware (e.g., smart mirrors and moisture sensors), software-as-a-service diagnostic applications, and dynamically formulated direct-to-consumer cosmetic brands. The foundation of the new-area development is deep neural networks for analysing complicated pictures of the skin. Research by prominent scholars has demonstrated that high-performance convolutional neural networks can reach the accuracy of dermatology for classifying all kinds of skin diseases, such as benign hyperpigmentation and malignant tumours [3]. Good scientific experiments have provided the foundation for clinical application and thus enabled the development of commercial AI cosmetics.

Economically speaking, artificial intelligence is now integrating the old ways with the new ways in healthcare and consumerism to form a future system [4]. The great foreign-owned cosmetic groups have now been aware of the existence of nimble, data-driven start-up companies. Therefore, these old companies have invested heavily in algorithm research and development, acquired well-known augmented reality and machine learning companies, and thus fortified their market positions defensively. Artificial intelligence can be employed to improve operational efficiency, reduce waste in the supply chain via on-demand production, and optimise targeted marketing to change the basic business model of the industry [7]. The model of revenue collection in the market is moving away from a product-based system to a service-type subscription model; thus, continuous algorithmic monitoring and personalised topical treatment will be offered via a recurring payment.

Although it has been developing economically at a high speed, many structural problems persist in the market. The first is to have real-life applications in the clinic and to meet the various demands of overseas regulations. To realize stable consumer applications for high-precision algorithmic research, the problems of algorithmic bias, non-representative datasets and

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hardware discrepancies among different mobile phones need to be addressed [8]. If an artificial intelligence skincare application is primarily trained on Caucasian skin types, its diagnostic accuracy and product recommendations for people with darker skin will be severely deficient in terms of both economy and clinical application. Given the above data deficiencies, it is not only ethically wrong but also economically unfeasible to tap into the global demographic revenue market and preserve the brand's general credibility. At the same time, new forms of competition are emerging in the integrated-edge-computing market. At the beginning of digital skincare, the rather complex image processing and neural network calculations needed to be performed in the cloud. As a result of the above architecture requirements, there is a relatively high latency, a large-scale server infrastructure cost, and increased anxiety among consumers over the remote storage of their private facial information. Recently, the new design of mobile processors has supported the operation of very small and high-efficiency AI models on-device by consumers. Edge computing can run the diagnostic algorithm for full-featured dermatological analysis locally and does not need to send the raw biometric image over the Internet. The technology will be applied to boost the competitiveness of the market at that time. It will reduce the company's cloud computing costs and provide a high-assurance privacy guarantee for end-users at the same time. Therefore, the ability to optimise proprietary diagnostic neural networks for low-power edge deployment has become one of the key technology battleships in recent years that will determine which companies lead in the new era of digital aesthetic.

4. Consumer Behavior and Technological Acceptance

To understand why artificial intelligence skincare products have recently become popular in the market, one needs to learn about the changes in consumer behaviour and psychology at the same time. At the beginning of this study, two key elements of the user's acceptance of new information technology systems were identified by a particular theoretical system: perceived usefulness and perceived ease of use [1]. Algorithmic skincare: Perceived usefulness directly refers to a consumer's belief that an artificial intelligence-driven diagnostic tool will produce better dermatological results than traditional cosmetic selection by hand. Promptly and visibly show the results of augmented reality try-on and predictive ageing simulations to make them more useful in a compelling way, thereby motivating consumers to buy higher-priced products based on data.

The adoption of medicalised algorithms is relatively more complex than that of standard software acquisition. Consumer behaviour in this area is driven by both the physical condition of the skin and other factors, such as mental stress, social demands and a sense of being led by an AI-aided health system [10]. Artificial intelligence skincare platforms have intentionally used the biopsychosocial nexus to create gamified interfaces and clinical terminology, thereby fostering a strong sense of psychological authority. If the algorithm believes that the severity of facial erythema or collagen damage is extremely high, it will be recognized as a medical issue and prompts will advise users to take prompt remedial measures based on specific suggestions given by the algorithm.

At the same time, a key reason for the limited application of this platform is a general lack of public trust in its protection of data and algorithms. Machine learning in medicine and personal health requires the collection of very personal and unchangeable biometric data as its foundation, and thus poses new ethical and legal problems [5]. Consumers have learned that their facial scans and genetic swabs will be used to train the company's private algorithms. If a disproportionate gain in information is achieved by the company without any accompanying improvement in consumer protection measures, trust in the company will decline rapidly. Therefore, successful market participants should be transparently behavioral economists, offer

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users real-life rewards such as product discounts or legally binding guarantees of data anonymisation, and retain their customers over the long term.

5. Conclusion

The artificial intelligence skincare industry is now a joint venture of cosmetic aesthetics, cutting-edge computational science and digital health economics. As shown in the overall analysis above, the trend of algorithmic dermatology in retail is not going anywhere; instead, it indicates that consumers have begun to apply their own physiological data in a new way. Through the lens of digital health economics, it can be seen that artificial intelligence has reduced information asymmetry to a certain extent, decreased empirical consumption waste, and successfully decentralised initial medical diagnosis. The market has been advancing rapidly in recent years and is no longer centred on the sale of fixed-item products, but rather on dynamic subscription services for biological monitoring.

At the same time, the behaviour of consumers in this area is a trade-off between the large-scale convenience offered by personalisation and deep-seated fears about data privacy and algorithmic bias. For the above technologies to be successfully implemented, there should be a psychological authority in the algorithm and sophisticated diagnostic functions need to be integrated into a simple, user-friendly mobile interface. Consumers are more willing to pay a higher price for skincare products if the basic recommendation process has been verified by an all-encompassing and open-source computer system.

The Direction of development for the AI skincare industry in the future will be guided by the ethics of biometric data. Increase the diversity of the dataset to address demographic bias in algorithms and improve both their generalisation ability and economic fairness. As the regulatory authorities will likely increase the demands for clinical-scientific evidence supporting medical-software applications, the industry needs to provide such data. Finally, the area of artificial intelligence skincare will be a new combination of digital technology and human biology to offer people a new level of personalised health management and economic efficiency.

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