Research on the Development of Artificial Intelligence Industry Based on Structural Equation Model - ChatGPT as an Example

Qingling Fan and Mengjie Ren(✉)

Chengdu University of Technology, Chengdu, China
1094285756@qq.com

Abstract. Based on the structural equation model, this paper mainly analyzes the influencing factors on the development of ChatGPT from four dimensions, and draws the main conclusions: ChatGPT has great advantages in application maturity; Subject factors are important factors affecting the development of ChatGPT; There is a causal relationship between information factors and industrial development; Social factors make ChatGPT the hottest AI technology at present.

Keywords: ChatGPT · Structural Equation Model · Artificial Intelligence

1 Introduction

1.1 What is ChatGPT

ChatGPT, an artificial intelligence generated content (AIGC) model developed by OpenAI, has attracted world wide attention for its capability of dealing with challenging language understanding and generation tasks in the form of conversations. ChatGPT is an intelligent chatting robot which is able to provide a detailed response according to an instruction in a prompt. As a member of AIGC, ChatGPT has shown powerful functions on various language understanding and generation tasks such as multilingual machine translation, code debugging, stroy writing, admitting mistakes and even rejecting in appropriate requests according to the official statement. Unlike previous chatting robots, ChatGPT is able to remember what the user has said earlier in the conversation which helps for continuous dialogue [1].

1.2 Research Methods

The idea of SEM originated from the concept of path analysis proposed by Sewll Wright [2] in the 2020s. Subsequently, in the 70s of the 20th century, Joreskog and other scholars integrated statistical methods such as factor analysis and path analysis and clearly proposed the concept of SEM. SEM often includes explicit variables and latent variables. Apparent variables, also known as observational variables, indicator variables or measurement variables, refer to variables that can be directly observed or measured, and the relationship between such variables can be called measurement models. In this paper,

G. Vilas et al. (Eds.): ICEMED 2023, AEBMR 254, pp. 406–413, 2023.
https://doi.org/10.2991/978-94-6463-224-8_50

SEM is used to analyze the interaction between application maturity, subject factors, information factors and social factors. SEM consists of two basic models: measurement model and structural model.

1.3 Data Support

Before the analysis, the questionnaire is designed to support the data of the model. The questionnaire is divided into four parts, the first part is people's basic cognition of artificial intelligence such as ChatGPT and the changes in existing life impacts; The second part is the extent to which the emergence of ChatGPT has an impact on the details of academic research, homework help, career planning, and psychological counseling in life; The third part is to investigate the motivation of ChatGPT use, access to information sources, advanced scientific research advantages, risk challenges, willingness to use, etc.; The fourth part is the basic information portrait of the surveyed group, including basic information such as gender, age, education level, occupation, and major.

A total of 580 formal questionnaires were distributed, 52 invalid questionnaires were eliminated, and 528 valid questionnaires were finally determined, with a recovery rate of 91.03%, and the effective questionnaire samples and recovery rates were consistent with the sampling design prediction, which was reasonable and scientific.

2 Analysis of Factors Influencing the Development of ChatGPT

2.1 Make a Hypothesis

(1) **Application Maturity**

A massive high-quality corpus base is one of the key elements of Chat GPT's technological breakthrough. Through pre-training with a large amount of unlabelled corpus, Chat GPT learns knowledge content such as linguistic expression patterns, pre- and post-textual logic, and relationships between knowledge elements, and on this basis, uses the high-quality labelled corpus for targeted fine-tuning to further enhance its conversational ability [3]. At the same time, we believe that there may be technical localisation features in ChatGPT at present. This is the case when conversations are more fluent in English than in other languages, and whether the birth of "Wenxin Yiyin" in China will affect its frequency of use. Xiao Feng (2023) believes that 'the machine's answers do not allow us to see the 'promising' scope that exists in these issues, but rather the 'indisputable' 'irrefutable' and 'naturally reasonable', suggesting that the view it generates is not comprehensive and broad enough for the study of digital labour, let alone reflecting the inexhaustible nature of academic research-based knowledge production' [4]. It is clear that there is still a lot of room for the development of artificial intelligence such as ChatGPT and "Wenyin Yixin". All in all, the technical support and localisation gives them an irreplaceable technological advantage and service quality. Therefore, when they are enhanced, they have a positive impact on user satisfaction.

Here the hypothesis is formulated:

H10: Application maturity has no significant positive impact on the development of ChatGPT

H1: Application maturity has a significant positive impact on the development of ChatGPT

(2) **Subject Factors**

In the field of user information behavior, the subject factor generally refers to the user's own factors, and there is a causal relationship with the user's willingness to use, which can be divided into emotional factors and cognitive factors [5]. We divides the subject factors into two aspects: perceptual attitude and freshness. Research on perceived risk is mostly manifested in privacy dimensions such as privacy risk perception and privacy disclosure. At the same time, there is a causal relationship between perceived risk and willingness to use, and users who perceive risk are more active [6]. Emotional factors are mainly perceived attitude and freshness. The higher the emotional factor, the more willing users are to use ChatGPT. Therefore, when the influence of the main factor is higher, it will have a positive impact on user satisfaction.

Here the hypothesis is formulated:

H20: Subject factors did not have a significant positive impact on the development of ChatGPT
H2: Subject factor has a significant positive impact on the development of ChatGPT

(3) **Information Factors**

Previous studies have mostly discussed information factors from the dimensions of information usefulness and information quality, and analyzed the relationship between information factors and willingness to use. We argues that there is a causal relationship between information factors and willingness to use, and information factors are divided into two dimensions: information security and diversified information output. Information security is mainly concerned about whether ChatGPT has the risk of data leakage and illegal collection of personal information. Some studies believe that ChatGPT changes the intelligence analysis mode of literature intelligence, from manual workshops to large-scale intelligent analysis, which can form diversified information output. Therefore, when the higher the information security and the more diversified information output, it will have a positive impact on user satisfaction.

Here the hypothesis is formulated:

H30: Information factors did not have a significant positive impact on the development of ChatGPT
H3: Information factor has a significant positive impact on the development of ChatGPT

(4) **Social Factors**

ChatGPT is a hot topic at the moment, and we believe that it is driven by both public opinion and social support. Public opinion mainly includes friends, various transmission of information on online platforms and media reports; Social support mainly includes professional teachers, industry intellectuals and Internet celebrities, policy and government support and other representative figures. Therefore, when the higher the public opinion orientation and social support, it will have a positive impact on user satisfaction.

Here the hypothesis is formulated:

H40: Social factors did not have a significant positive impact on the development of ChatGPT

H4: Social factor has a significant positive impact on the development of ChatGPT

2.2 Factor and Reliability Analysis

(1) **Factor Analysis**

This shows the results of Pearson correlation analysis and AVE root values between factors. It can be seen that the square root of the mean variance extraction (AVE) of the factor is greater than the Pearson correlation coefficient values of other factors, indicating its excellent discriminant validity. The clinodiagonal is the square root of the mean variance extraction, indicating a strong correlation within the factors. As shown in Table 1.

The diagonal number is the root value of the factor AVE

(2) **Reliability Analysis**

Reliability, refers to the use of the same method to measure the same sample multiple times and ultimately test the consistency of the results. It represents whether the questionnaire filled out by the respondents has a certain degree of stability and credibility. It is generally believed that a reliability coefficient of 0.65–0.7 is the minimum acceptable range, with a value above 0.7 being quite good, and a value above 0.8 being excellent. We use SPSS to calculate Cronbach's α, This shows the results of Pearson correlation analysis and AVE root values between factors. It can be seen that the square root of the mean variance extraction (AVE) of the factor is greater than the Pearson correlation coefficient values of other factors, indicating its excellent discriminant validity. The clinodiagonal is the square root of the mean variance extraction, indicating a strong correlation within the factors. As shown in Table 2.

The value of this model is 0.865, indicating a good reliability of the questionnaire. Therefore, we can use the data from this questionnaire tor analysis.

Table 1. Latent variable correlation matrix

Discriminant Validity: PearsonCorrelation&AVE Root Value					
	Subject factors	Social factors	Application maturity	Information factors	Developments
Subject factors	0.824				
Social factors	−0.019	0.871			
Application maturity	−0.006	0.001	0.847		
Information factors	−0.103	−0.015	0.063	0.853	
Developments	0.167	0.421	0.367	0.497	0.785

Note: *** , *** *, * represent the significance levels of 1%, 5% and 10%, respectively

Table 2. Cronbach's α coefficient value

Cronbach's α coefficient	Standardized Cronbach' αcoefficient	Items	Samples
0.865	0.866	4	528

2.3 Model Explanation

This modeling was conducted using AMOS software. After setting up the causal relationship path diagram as required, the results were obtained after running, This shows the results of Pearson correlation analysis and AVE root values between factors. It can be seen that the square root of the mean variance extraction (AVE) of the factor is greater than the Pearson correlation coefficient values of other factors, indicating its excellent discriminant validity. The clinodiagonal is the square root of the mean variance extraction, indicating a strong correlation within the factors. As shown in Fig. 1.

The below table shows the regression coefficients of path nodes, which can be understood as a least squares univariate linear regression. Usually, only the P-value and standardized path coefficients need to be observed to determine whether the path (X -> Y) has a direct linear impact. According to the significance test analysis ($P < 0.05$), whether there is an impact relationship between model variables. If there is significance, it indicates that there is an impact relationship between variables. The standardized path coefficient can be used to conduct in-depth analysis of the impact efficiency. As shown in Table 3.

From the path coefficient table of this model, it can be seen that:

Based on assumptions H1, H2, H3, and H4, the significance P-values are all 0.000 * * *, showing significance horizontally. Therefore, the original hypothesis is rejected, and all four paths are valid.

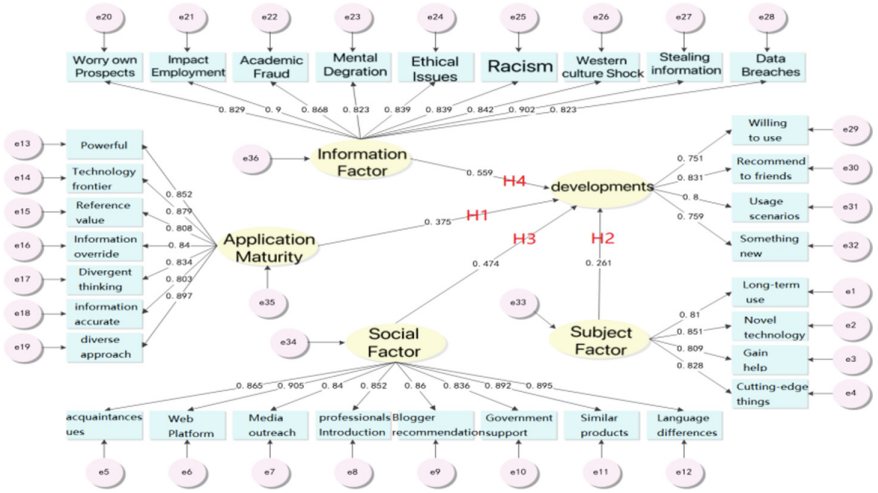

Fig. 1. Structural Equation Model

Table 3. Table of factor covariance coefficients

Hypothesis	Factor	→	Analytical Items	Unstandardized Coefficients	Standardized Coefficients	standard error	Z value	P value
H1	Application maturity	→	Developments	0.215	0.261	0.028	7.675	0.000***
H2	Subject factors	→	Developments	0.330	0.474	0.026	12.888	0.000***
H3	Information factors	→	Developments	0.275	0.375	0.026	10.760	0.000***
H4	Social factors	→	Developments	0.428	0.559	0.031	13.842	0.000***

Note: ***, ****, * represent the significance levels of 1%, 5% and 10%, respectively

3 Conclusion

3.1 ChatGPT has a Great Advantage in Terms of Application Maturity

The application maturity of this paper mainly includes two aspects: technology localization and technical supports. In terms of technical supports, ChatGPT has greater technical and comparative advantages than other artificial intelligence technologies, with 71.21% of respondents believing that ChatGPT is very powerful. At the same time, 74.24% of the respondents believe that the information provided by ChatGPT is of reference significance and the information coverage is relatively wide. Regarding the technical localization of ChatGPT, 73.1% of respondents said that ChatGPT responds quickly in the English context, while there is a certain technical "intellectual disability" in the Chinese context; 78.97% of the respondents are worried that whether the emergence of "Wen Xin Yiyan" in China will affect the use of the situation is a problem that we need to explore. In general, the application maturity of ChatGPT is ahead of similar artificial intelligence technologies, and it has successfully broken through the strange circle of "artificial intelligence to artificial intellectual disability".

3.2 The Subject Factor Is an Important Factor Affecting the Willingness of ChatGPT Users to Use it Perceptual Attitude

The main factors of this paper are mainly divided into two aspects: perceptual attitude and freshness. We believe that ChatGPT has strong attractiveness and functional innovation, which can stimulate users' willingness to use it, but compared with other information system and application users, users' perceived risk is particularly strong and obvious. The study found that users' perceptual attitude is high, with 78.9% of respondents saying that ChatGPT writing and statistics are too powerful and are likely to replace their jobs; 78.41% of respondents are more worried about the survival prospects of ChatGPT. At the same time, users have a high sense of freshness in ChatGPT. Most respondents believe that ChatGPT helps them in their academic life and can learn more cutting-edge things through ChatGPT. More than two-thirds of respondents said that they had a lot of expectations before using ChatGPT, and felt that ChatGPT met their expectations after

using it. In general, the subject factor is an important factor that affects whether people are willing to continue using ChatGPT.

3.3 There Is a Causal Relationship Between Information Factors and Industrial Development

The results of this paper show that there is a causal relationship between information factors and industry development, and information factors are divided into two dimensions: information security and diversified information output. Information security is currently a top concern: nearly 3/4 of respondents are concerned about the risk of data breaches and illegal collection of personal information on ChatGPT. For example, the recent news of information leakage caused by Samsung Semiconductor employees using ChatGPT will directly affect people's use of ChatGPT, so as to affect the development of the ChatGPT industry. In terms of diversified information output, 73.29% and 75.76% of respondents believe that ChatGPT can diverge thinking and provide them with multiple solutions, showing positive views. 75.76% of respondents believe that ChatGPT itself has no value evaluation standards, but ChatGPT is developed by technicians in other countries and rooted in the Western value system, and the information output will inevitably contain Westernized values. In general, although OpenAI has set many protection mechanisms for ChatGPT, shielding and optimizing some sensitive information, once ChatGPT is cracked and used by bad businesses and hostile forces, the state of "emotional collapse" is likely to mislead users and seriously threaten the value system of human society.

3.4 Social Factors Make ChatGPT the Hottest AI Technology at Present

This paper divides social factors into two main aspects: public opinion and social support. Public opinion mainly includes the propagate and guidance of traditional news media, online new media, as well as the influence of close social relationships such as relatives and friends, and about 70% of respondents believe that public opinion guidance has a great impact on them; Social support sleeves include not only the influence and radiation of internet celebrity, well-known bloggers, etc., but also the industry influence of academic experts such as famous scholars and field experts, and about 73% of respondents believe that social support has a great impact on them. Whether traditional media or new media are vigorously promoting the functions and technologies, coupled with the promotion of opinion leaders, ChatGPT is destined to become the hottest artificial intelligence technology at present, and it has promoted the development of the entire AI industry to a certain extent.

References

1. Wu T, He S, Liu J, et al. A Brief Overview of ChatGPT: The History, Status Quo and Potential Future Development[J]. IEEE/CAA Journal of Automatica Sinica,2023,10(05):1122–1136.
2. HAN Shifan, JIA Xiaoyue, CAO Yan. Application status of structural equation model in nursing research[J]. General Nursing,2019,17(31):3880–3883.

3. QIAN Li, LIU Yi, ZHANG Zhixiong, LI Xuesi, XIE Jing, XU Qinya, LI Yang, GUAN Zhengyi, LI Xiyu, WEN Sen. Data Analysis and Knowledge Discovery,2023,7(03):6–15.
4. XIAO Feng. Analysis of the Function of Generative Artificial Intelligence in Knowledge Production: Exploring the Experience of Digital Labor with the Help of ChatGPT and "Wen Xin Yiyan" [J]. Journal of Chongqing University of Posts and Telecommunications(Social Science Edition):1–11.
5. ZHANG Hai. Research on the conceptual framework of the formation mechanism of network user information cocoon[J]. Information Theory & Practice,2021,44(11):60–64+107.
6. LI Yingying, CHEN Tingting, SUN Yuqi. Research on influencing factors of user privacy risk perception in social media intelligent recommendation[J]. Journal of Intelligence,2023,42(02):151–157.