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ASSESSING THE SUCCESS OF ARTIFICIAL INTELLIGENCE TOOLS: AN EVALUATION OF CHATGPT USING THE INFORMATION SYSTEM SUCCESS MODEL

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ABSTRACT

Artificial Intelligence tools have gained significant attention in recent years due to their potential to transform various sectors by automating tasks, improving efficiency, and enhancing decision-making processes. This paper explores the success of Artificial Intelligence tools, particularly ChatGPT, using the Information System-success-based framework from the perspective of users. Structural Equation Modeling techniques were applied to data collected from users of ChatGPT. The study empirically evaluated a model for measuring the success of Artificial Intelligence tools, incorporating constructs from the updated DeLone and McLean Information System success model. Four out of five hypothesized relationships between the success variables were significantly supported. The findings of this study can be used to assess the success of Artificial Intelligence tools like ChatGPT from the standpoint of their users.

KEY WORDS

artificial intelligence, ChatGPT, IS success, DeLone and McLean, SEM

CLASSIFICATION

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INTRODUCTION

Artificial Intelligence (AI) tools, such as ChatGPT, have gained significant attention in recent years due to their potential to transform various sectors by automating tasks, improving efficiency, and enhancing decision-making processes [1]. AI tools leverage natural language processing (NLP) to understand and generate human-like text, making them invaluable in areas such as customer service, content creation, and education [2]. OpenAI developed ChatGPT, a conversational, generative artificial intelligence. Released on November 30, 2022, it exceeded 100 million monthly users within just two months [3]. Despite their widespread adoption, there is a need to evaluate and measure their success systematically.

The advantages of ChatGPT are numerous [4, 5]. It enables efficient management of human resources and time by facilitating simple searches and report generation. While existing knowledge search services like Google and Naver are available, ChatGPT offers the benefit of more precise and real-time applications. Despite this, much of the current research on ChatGPT has concentrated on its technological and ethical implications and learning aspects. As ChatGPT, an AI language-based tool, is used by many individuals, it is essential to assess its success and the benefits for its user [6]. The DeLone and McLean information systems (IS) success model (D&M model) has been extensively used to assess IS success across various domains. This model includes constructs like system quality, information quality, service quality, use, user satisfaction, and net benefits. However, the application of this model to AI tools, specifically ChatGPT, remains underexplored. This study aims to fill this gap by empirically evaluating the success of ChatGPT using the D&M model, with a focus on user perspectives.

This study introduces an empirically validated model for evaluating the success of ChatGPT as an AI tool within organizations from the users' perspective. The research employs the updated DeLone and McLean IS success model. Data was gathered from 2 897 students across various STEM disciplines using a questionnaire. These students used ChatGPT for their homework, research and writing assignments. Four out of five hypothesized relationships between success variables were significantly supported. The findings of this study can be utilized to assess the success of ChatGPT from the users' viewpoint, develop effective AI integration strategies, and enhance overall organizational performance.

The article is organized as follows: Section 2 presents a background and related work on AI tools and the applicability of IS success modelling, along with a proposed conceptual model and hypothesis. Section 3 details the materials and methods used. Section 4 discusses the results of measurement and structural modelling. Section 5 explores the theoretical and managerial implications of the ChatGPT success model. Finally, Section 6 provides conclusions and directions for future research.

BACKGROUND AND RELATED WORK

ARTIFICIAL INTELLIGENCE TOOLS AND CHATGPT

AI tools, particularly those based on numerous NLP, have revolutionized the way information and services are delivered to users [1]. ChatGPT, developed by OpenAI, is a state-of-the-art language model capable of understanding and generating human-like text [7]. It has been used in various applications, including chatbots, virtual assistants, and content creation tools. The success of such tools can be measured by their ability to deliver accurate, relevant, and timely responses to users, thereby enhancing user satisfaction and overall utility. ChatGPT is an advanced conversational AI developed by OpenAI, designed to follow instructions from prompts and provide detailed responses. It can facilitate interactions through messaging applications and websites, enabling conversations with real people [8]. One of the key features

of ChatGPT is its character-based interaction without time and space constraints. Its primary task is to meet users' information search needs. Another important discussion is the ethical implications of using ChatGPT. Chu highlighted significant concerns regarding academic writing and test integrity [3]. Previous studies using the Human ChatGPT Comparison Corpus found that ChatGPT's responses were narrowly focused on specific subjects [3].

INFORMATION SYSTEM SUCCESS MODELS

The DeLone and McLean (D&M) IS success model, first introduced in 1992, is a foundational framework for assessing IS effectiveness [9]. In 2003, DeLone and McLean updated their model (Figure 1) to better fit the Internet era, especially with the rise of electronic commerce [10]. This updated model introduced a third quality dimension – service quality, as suggested by Pitt et al. [11], and combined individual impact and organizational impact into a single construct – net benefits. The revised D&M IS success model now includes six interrelated and interdependent dimensions: system quality, information quality, service quality, system use, user satisfaction, and net benefits [12]. The updated model has been applied in various contexts, including the assessment of IS effectiveness in the World Wide Web environment and e-government systems. It is one of the most widely used models for evaluating IS success and continues to serve as a significant basis for subsequent research. Studies have demonstrated its applicability across different settings, with a focus on user evaluations obtained from surveys and Structural Equation Modeling (SEM) [13]. The original authors have also emphasized the need for further field studies to refine and validate the model, ensuring its relevance and accuracy in contemporary IS environments [10]. However, its application to AI tools like ChatGPT requires further investigation.

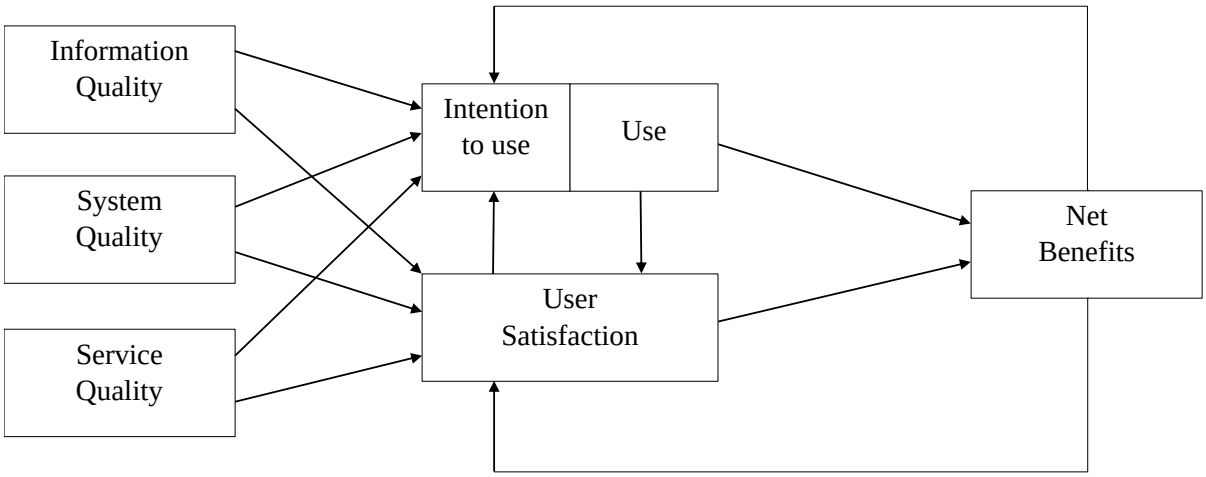

Figure 1. The updated DeLone and McLean IS success model [10].

CONCEPTUAL MODEL AND HYPOTHESES

Based on the D&M model, this study proposes a conceptual model for assessing the success of ChatGPT, incorporating the following constructs:

- System Quality (SQ): Refers to the technical performance of ChatGPT, including its ease of use, user-friendliness, and overall usability.
- Use (Use): Refers to the degree and manner in which users utilize ChatGPT.
- User Satisfaction (US): Refers to the overall satisfaction of users with ChatGPT, including their perceptions of its utility and effectiveness.
- Net Benefits (NB): Refers to the perceived benefits users derive from using ChatGPT, including time savings, improved productivity, and enhanced decision-making.

According to Figure 2, the updated D&M model is used to measure the success of AI systems. DeLone and McLean [11] contend that use and the intention to use are alternatives in their model, and that the intention to use may be a more acceptable variable in the context of mandatory usage. Thus, we chose to consider both the intention to use, and other measures of system use as the same construct for this study.

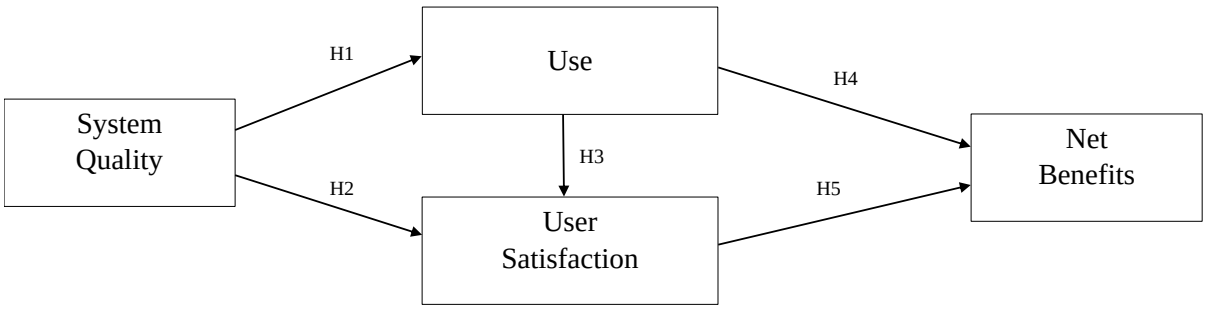

Figure 2. Conceptual Model.

IS success is a multidimensional and interdependent construct and it is therefore necessary to study the interrelationships among those dimensions [10]. The following hypotheses are proposed:

H_1: System quality positively affects the use of ChatGPT.
H_2: System quality positively affects user satisfaction with ChatGPT.
H_3: Use positively affects user satisfaction with ChatGPT.
H_4: Use positively affects net benefits from using ChatGPT.
H_5: User satisfaction positively affects net benefits from using ChatGPT.

MATERIALS AND METHODS

MEASURES

The constructs were measured using validated 15 indicators from previous research on IS success. Each indicator was assessed using a five-point Likert scale. The constructs and their indicators are listed in Table 1.

Table 1. Construct measures for AI system success.

Construct	Indicator	References
System quality (SQ)	(1) Easy to use	[10], [14]
	(2) User-friendly	[10], [12]
	(3) Overall usability	[6], [12]
	(4) Functionality	[6], [12]
Use (Use)	(5) Frequency of system use	[15], [16]
	(6) Tendency to use	[16], [18]
	(7) Duration of future use	[18]
User satisfaction (US)	(8) Satisfaction with system	[15]
	(9) Perceived utility	[16]
	(10) Expectations	[17]
Net Benefits (NB)	(11) Improved productivity	[17]
	(12) Time savings	[10], [15]
	(13) Enhanced decision-making	[19]
	(14) Improved performance	[3]
	(15) Useful	[3]

SAMPLE AND DATA COLLECTION

Data were collected from a sample of ChatGPT users from university students. The focus was on students who used ChatGPT during their study. Purposive sampling was used, a type of non-probability sampling in which the researcher's judgment is used to select which individuals of the population to include in the study. Following Dillman's [20] recommendations of applying the total design method of surveys, we e-mailed 15 000 STEM students. A total of 2 897 responses were received over a period of 10 weeks, representing a response rate of 19.3 %. Approximately, 54.8 % of the respondents were male. The majority of the respondents were younger than 30 (97.6 %). Regarding AI skills for using ChatGPT, most respondents disclosed to be able to use AI for simple tasks (54.7 %) The demographic composition of the sample is shown in Table 2.

Table 2. The demographic composition.

Characteristic	Number	Percentage
Gender		
Female	1308	45.2
Male	1589	54.8
Age		
<30	2828	97.6
31-40	56	1.9
41-50	10	0.3
>50	3	0.1
AI skills		
Beginner	159	5.5
Able to use AI for simple tasks	1584	54.7
Expert	1154	39.8

RESULTS

In general, Structural Equitation Modeling (SEM) technique was conducted in SPSS Amos to assess the measurement model, and to test the hypotheses in the structural model.

MEASUREMENT MODEL

For the purpose of validity testing of the measurement model, the Confirmatory Factor Analysis (CFA) was conducted by SPSS Amos [21]. We used the following goodness of fit indices: the ratio of $\chi 2$ to degrees-of-freedom (df), adjusted goodness of fit index (AGFI), normalized fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). As shown in Table 3, all the model-fit indices exceeded their respective common acceptance levels suggested by previous research [22-24], thus demonstrating that the measurement model exhibited a fairly good fit with the data collected ($\chi 2 = 937$ with df = 79, AGFI = 0.936, NFI = 0.976, CFI = 0.978 and RMSEA = 0.061).

Table 3. Summary of goodness of fit statistics for CFA and SEM (AGFI – adjusted goodness of fit index, NFI – normalized fit index, CFI – comparative fit index and RMSEA – root-mean-square error of approximation).

Model	AGFI	NFI	CFI	RMSEA
Measurement model	0.936	0.976	0.978	0.061
Structural model	0.898	0.960	0.962	0.077
Recommended value	> 0.80[b]	> 0.90[b, c]	> 0.90[a, c]	< 0.08[a, b, c]

[a][25], [b][26][c][23]

Reliability was evaluated by calculating Cronbach's α coefficients [27]. The reliability of each factor collected by the survey instrument was as follows: system quality = 0.899; use = 0.894; user satisfaction = 0.939; net benefit = 0.927. And the reliability of the whole instrument was 0.932. In addition, the reliability and convergent validity of the factors were estimated by the Composite Reliability (CR) and Average Variance Extracted (AVE). The results are presented in Table 4. All the Cronbach's alpha coefficients and composite reliability values satisfied the minimum criterion value of 0.70 or greater, as suggested by Hair et al. [26]. The average variances extracted were all above the recommended 0.50 level [23], which meant that more than one half of the variances observed in the items were accounted for by their hypothesized factors. CR was greater than AVE for each factor. Thus, all the factors in the measurement model had adequate convergent validity.

Table 4. Reliability, convergent validity, and construct correlations (α – Cronbach's alpha, CR – composite reliability, AVE – average variance extracted, MSV – maximum shared variance, ASV – average shared variance).

Factor	Mean	SD	α	CR	AVE	MSV	ASV	SQ	U	US	NB
SQ	4.21	0.91	0.899	0.940	0.840	0.626	0.442	0.917a			
Use	4.33	0.81	0.894	0.902	0.698	0.554	0.350	0.744	0.836[a]		
US	3.80	1.20	0.939	0.828	0.642	0.202	0.140	0.383	0.449	0.801[a]	
NB	3.28	1.27	0.927	0.927	0.718	0.626	0.331	0.791	0.544	0.265	0.848[a]

[a]indicates the square root of AVE of the construct

Discriminant validity can be evaluated by examining the Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV). Following Hair et al. [26] recommendation, MSV greater than AVE and ASV greater than AVE will lead to discriminant validity. None of the factors had convergent validity concerns, Table 4. In summary, the measurement model had adequate reliability, convergent validity, and discriminant validity.

Next, we conducted the Common Method Bias (CMB) test. CMB refers to the measurement error resulting from variance due to the measurement method utilized [28]. Common Latent Factor (CLF) test is employed to examine for common method bias. This test is conducted to capture the common variance among all the observed variables in the model [28]. If there are great differences (greater than 0.2) in the standardized regression weights from the model with CLF to the standardized regression weights of a model without the CLF, then there is a CMB issue [28]. Using this approach, CLF test of the items in our study was conducted. This analysis showed that the differences in the standardized regression weights with and without CLF were smaller than 0.2 in all observed variables, which is a strong indication that common method bias is not present in our sample.

STRUCTURAL MODEL

The same set of fit indices was used to examine the structural model. As Table 3 shows, all fit indices values are in the acceptable range, indicating a good fit of the model ($\chi 2$=1542 with df=85, AGFI=0.898, NFI=0.960, CFI=0.962, RMSEA=0.077). Path coefficients, p-values, z-scores, and variance explained are shown in Figure 3.

The results indicate that four out of five hypotheses were supported. System quality had a significant influence on use and user satisfaction. Thus, $\mathbf{H_1}$ (β = 0.454; t = 22.825) and $\mathbf{H_2}$ was supported (β = 0.700; t = 33.709). Use had a positive significant influence on user satisfaction and negative on net benefits. Thus, $\mathbf{H_3}$ was supported (β = 0.065; t = 3.915) and $\mathbf{H_4}$ was rejected (β = -0.045; t = -3.185). Finally, user satisfaction had a positive effect on net benefits. Thus, $\mathbf{H_5}$ was supported (β = 0.811; t = 44.547). The findings regarding the five hypotheses are summarized in Table 5.

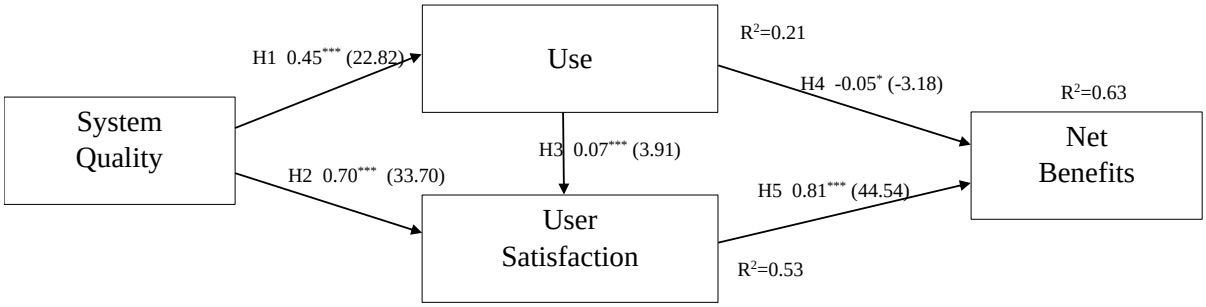

Figure 3. Structural model. Statistical significance is *p < 0.05, ***p < 0.001; () z-score.

Table 5. Summary of hypotheses testing.

Hypothesis	Relationship	t-value	β-value	Result
H_1	SQ → U	22.825***	0.454	Supported
H_2	SQ → US	33.709***	0.700	Supported
H_3	U → US	3.915***	0.065	Supported
H_4	U → NB	-3.185*	-0.045	Not supported
H_5	US → NB	44.547***	0.811	Supported

*significant at the level $p < 0.05$

***significant at the level $p < 0.001$

DISCUSSION

This research addresses the challenge of evaluating the success of AI tools, particularly ChatGPT, from the user's perspective using the IS-success-based framework. We have empirically validated the model for assessing AI system success based on the updated DeLone and McLean (D&M) IS success model [10]. This study highlights how system quality, usage, and user satisfaction influence the perceived benefits of using ChatGPT. The findings provide crucial insights into user interactions with ChatGPT, enhancing our understanding of the factors that contribute to its effectiveness and utility.

The study offers significant theoretical and practical implications for AI system success. Our model and structural equations indicate that technical quality is a key component in measuring ChatGPT's success. The findings show a positive correlation between system quality and both ChatGPT usage and user satisfaction, emphasizing the importance of technical robustness, usability, and user-friendliness in shaping positive user attitudes. Additionally, the results confirm a positive and statistically significant relationship between system usage and user satisfaction. This suggests that increased use of ChatGPT leads to higher user satisfaction, reflecting the system's perceived efficacy and utility. However, it is noteworthy that while system usage enhances user satisfaction, it negatively impacts net benefits. This indicates that although greater engagement with ChatGPT increases user satisfaction, it may hinder the realization of tangible benefits, possibly due to time constraints or inefficiencies in leveraging the system's functionalities. Interestingly, the analysis reveals a positive relationship between user satisfaction and net benefits, highlighting user satisfaction as a crucial factor for deriving meaningful benefits from ChatGPT utilization. Satisfied users are more likely to perceive the system's advantages and effectively use its functionalities to achieve their goals. In line with existing literature on IS success, particularly the D&M IS success model [10], our findings underscore the multidimensional nature of user perceptions and experiences. Similar to other information systems [3, 8], where technical quality influences system success, ChatGPT's success depends on factors such as system quality, usage patterns, and user satisfaction.

Practically, these findings have significant implications for the design, implementation, and management of conversational AI systems like ChatGPT. It is essential to optimize system quality to enhance user experiences, encourage increased usage, and ensure users derive tangible benefits from their interactions. Additionally, strategies to boost user satisfaction can drive the full potential of ChatGPT, increasing its efficacy and value proposition [29].

Our model highlights the importance of system quality, usage, and user satisfaction in achieving benefits such as improved productivity, time savings, enhanced decision-making, and better performance for university students. Practically, university management should measure students' digital competencies and assess their productivity and efficiency every six months. Using our instrument, university management can evaluate the overall strength and effectiveness of ChatGPT in education. This information enables decision-makers to take corrective actions to enhance student effectiveness, develop strategies to address problems, and provide better services to students.

CONCLUSION

The study validates the D&M IS success model in the context of AI tools like ChatGPT. A field survey was conducted with STEM students to test the model. The empirical results verified the validity of the updated D&M success model in the context of AI tools. Four out of five hypotheses were supported. Our analysis showed that the system quality dimension had a positive impact on use and user satisfaction. Use had a positive and direct effect on user satisfaction and a negative effect on net benefits. Only user satisfaction is significant in predicting net benefits from using ChatGPT.

With respect to the IS success model of DeLone and McLean [10], this research has its limitations as we did not examine the feedback that could relate other quality dimensions (i.e, information and service quality) to use and user satisfaction. Attention to such feedback should be paid in future studies in order to investigate the interrelationships and to understand the IS success model more thoroughly.

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