

Incorporating Financial Knowledge with ChatGPT to Make Informed Investment Decisions

Ali Hameed Hindi Al-Ali ^{1*}, Sarah S. Sarhan Al-Ruaziq ¹, Ghassan Rashad Abdulhameed ¹

¹ Faculty of Administration and Economics, University of Kufa, Najaf, Iraq

* **Corresponding Author:** alih.alali@uokufa.edu.iq

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ABSTRACT

The present paper aims to assess the potential of AI technologies, such as ChatGPT, in the field of finance, by incorporating financial knowledge with ChatGPT to facilitate informed investment decisions. The research was designed based on the empirical study method, which tests hypotheses regarding the impact of financial knowledge within ChatGPT across three levels: Normal Financial Knowledge, Experienced Financial Knowledge, and Profound Financial Knowledge. These levels serve as independent variables, while informed investment decisions represent the dependent variable. Based on the case study method, this research is designed to provide empirical evidence regarding the integration of financial knowledge with ChatGPT to facilitate informed investment decisions. It employs artificial intelligence systems as the study population, with a sample consisting of ninety tested cases conducted on the ChatGPT platform using the purposive sampling technique. The data collected is in the form of documentary data resulting from direct testing by researchers through inquiries posed to ChatGPT on the OpenAI website. The study's most significant findings highlight ChatGPT's inability to provide equal opportunities for users, particularly for those requiring financial literacy. Consequently, not all users can make informed investment decisions. Therefore, the study suggests the necessity of enhancing certain aspects of ChatGPT. This could include incorporating mathematical equations and tables, along with offering users multiple response options for each question posed. This research can be the first local empirical research to evaluate AI technologies by incorporating financial knowledge with ChatGPT to make informed investment decisions.

Keywords: Financial Knowledge, ChatGPT, AI Technologies, Informed Investment Decisions.

INTRODUCTION

Financial knowledge plays a crucial role in achieving success, as individuals' possession of information and their understanding of artificial intelligence systems aid them in making investment decisions that can yield significant and high returns (Lind et al., 2020) define financial knowledge as the measure of an individual's understanding and confidence in utilizing their financial expertise to make sound financial decisions. It encompasses the ability to manage financial matters. The researchers support the notion that individuals with strong financial knowledge are capable of making informed investment decisions. Meanwhile, the findings from the study by Rachapaettayakom, Wiriyapinit, Cooharojananone, Tanthanongsakkun, and Charoenruk (2020) indicate that the acquisition of knowledge impacts business performance.

Through the technological developments and transformations that the world has witnessed recently, financial management witnessed the emergence of a new application represented by the techniques of artificial intelligence and machine learning, ChatGPT, which caused a great revolution recently, reflected in the occurrence of

transformations in some applications in the world. These AI technologies have been developed to make them simulate human mental capabilities, as artificial intelligence systems have the ability to learn and benefit from knowledge to achieve specific goals and tasks that enable them to make informed investment decisions. Researchers believe that investment decisions depend mainly on financial knowledge, as whenever an individual possesses high information and skills using ChatGPT, this makes him able to make good investment decisions.

Artificial intelligence mimics human cognitive abilities, as AI systems possess the capacity to learn, infer, and accurately interpret data. They can leverage knowledge to accomplish specific goals and tasks. The utilization of artificial intelligence systems, particularly Chatbots or ChatGPT, streamlines information access for users, reducing both the time and costs associated with retrieval (Alnefaie, Singh, Kocaballi, & Prasad, 2021). Researchers believe that many individuals exhibit reluctance to adopt artificial intelligence systems for several reasons. These include a lack of adequate technology knowledge, resulting in prolonged information retrieval times. Additionally, concerns arise around the incapacity to safeguard data due to potential program vulnerabilities susceptible to hacking by malicious actors. While Artificial Intelligence has indeed offered numerous advantages to both companies and users, there is one important consideration to take into account. Chatbots have played a significant role in elevating the quality of customer service. This is evidenced by their capacity to minimize the effort and time required to access services, all while ensuring the utmost levels of customer satisfaction (Adam, Wessel, & Benlian, 2021). However, researchers hold differing viewpoints for two primary reasons. Firstly, artificial intelligence systems or the methodologies employed within them can occasionally encounter failures in service provision (as seen in case 87), which subsequently impacts the customer's perception and their level of expectations from the service provider. Secondly, artificial intelligence systems may fall short in addressing all problems or fulfilling every user's needs, owing to the evolving and intricate nature of challenges faced by customers (as observed in case 62). This can lead to a genuine sense of disappointment among users, occasionally resulting in a reluctance to engage with intelligent systems. This scenario runs counter to the overarching concept of artificial intelligence.

Lim, Kumar, Verma, and Chaturvedi (2022) contend that conversational commerce signifies the future of business, encompassing human-like advantages that streamline service provision, and they anticipate a seamless interaction between humans and machines. Nonetheless, we maintain a contrasting viewpoint. While human-to-human interaction is undoubtedly instinctual, interactions with machines via technological agents and protocols generally center on automating interactive processes and activities to facilitate service acquisition. This might occasionally deviate from the norm due to technical glitches within these machines and the tools that rely on them, particularly when individual control is involved, such as in the "bird's eye view" method used in the study. The study also introduced the use of Chatbots to identify states of anxiety and depression experienced by users (Salas-Pilco & Yang, 2022). Researchers contested this idea, emphasizing that artificial intelligence systems, especially Chatbots, do not possess the ability to accurately determine a user's emotional state. The study brought to light several ethical dilemmas associated with (ChatGPT), particularly the existence of biases in its responses related to race and gender. Additionally, the study elicits questions about aspects connected to publication and plagiarism (Shahriar & Hayawi, 2023). The researchers endorsed this concept, pointing to people's hesitancy in interacting with (ChatGPT) due to concerns about breaching their privacy, disclosing personal information, as well as infringing upon individual property rights. There are also apprehensions about responses that display bias against race and gender.

ChatGPT effectively responds to individual questions; however, its accuracy diminishes when dealing with multiple-choice questions. This indicates that the program requires additional refinement and model validation (Hoch et al., 2023). Thus, an enhanced refinement is required to facilitate the incorporation of multiple options. According to Hariri (2023), artificial intelligence systems have ushered in a revolution in human-machine interaction, driving transformative changes across various global applications. Take Chatbots, for instance—they adeptly engage with customers in a manner that is both natural and reminiscent of human conversation. This includes furnishing information and addressing queries (Bubeck et al., 2023) concurred with the aforementioned viewpoint, asserting that Open AI & GPT-4 stand as the most advanced iterations within the realm of artificial intelligence systems. These versions adeptly handle intricate tasks, including complex mathematical equations, demonstrating a performance that closely parallels, if not surpasses, human capabilities. We hold a contrasting perspective regarding the notion of machines being superior to humans, as it is humans who have designed them and possess the capability to intentionally introduce issues for personal gain. The findings from the study conducted by Susnjak (2023) reveal that artificial intelligence systems offer the potential to elucidate models, enabling institutions to effectively engage with all stakeholders. Researchers concur that while artificial intelligence systems cannot be exclusively relied upon for all matters, it remains essential to turn to specialized stakeholders for obtaining precise information, given its consequential impact on investment decisions.

LITERATURE REVIEW

The acquisition of knowledge profoundly impacts business performance, for both individuals and institutions. Larger organizations typically offer internal programs to facilitate knowledge acquisition and personal growth among their members. Conversely, smaller institutions often lack such provisions. Financial acumen plays a pivotal role in empowering individuals to craft prudent investment choices. This holds true regardless of an institution's size—be it modest or extensive. Individuals are required to possess a comprehensive understanding of financial intricacies within their specialized domains. Moreover, staying attuned to advancements and modern technologies is crucial for making well-informed investment decisions. The study's findings highlighted that individuals with extensive financial knowledge are better equipped to make sound financial decisions (Indriaswari, Ulupui, & Warokka, 2022). We concur with the study's assertion, as individuals possessing substantial financial acumen are adept at navigating complex financial challenges and making informed decisions., we agreed with what was stated in the study because individuals who have high financial knowledge are able to face financial problems that you wear them and make good financial decisions (Appendix-3).

The study by Panjaitan, Renaldo, and Suyono (2022) characterizes financial knowledge as the capacity to comprehend, analyze, and oversee financial matters, enabling informed decisions that prevent financial predicaments. Acquiring financial knowledge necessitates honing financial skills and mastering the utilization of financial tools. Sahara, Fuad, and Setianingsih (2022) and Wahyuniati, Ibnu, and Jumadania (2022) concur with the preceding study, asserting that financial knowledge encompasses comprehension of all financial aspects and tools, including their proficient utilization. The possession of financial information and skills empowers individuals to make informed investment decisions. The researchers aligned with the viewpoints of prior studies, affirming that enhancing an individual's knowledge base, skills, and staying current with advancements aids them in effectively overseeing, enhancing, and upholding their institution's competitive standing within the market. Sidor and Manaęe (2023) highlighted that individuals with greater financial knowledge possess the capability to make well-informed investment choices. Researchers endorsed the study's concepts, affirming that individuals equipped with comprehensive information can effectively manage an institution and sustain its competitive edge in the market. The study's findings (Yue, D. Au, C. C. Au, & Iu, 2023) indicated that ChatGPT has the potential to ensure equal opportunities for all users, allowing individuals to make reasoned financial decisions regardless of their financial backgrounds. However, this outcome appears contradictory due to the presence of financial ignorance among individuals, which pertains to their lack of fundamental financial knowledge. Similarly, considering varying degrees of technological expertise, not all individuals can derive the same advantages from utilizing artificial intelligence systems like ChatGPT. Consequently, investment decisions become disparate and susceptible to misinformation. The study (Bubeck et al., 2023) agrees with our perspective, highlighting that inequalities among individuals who have access to smart systems and those who don't could hinder their ability to work optimally or as expected.

To determine the levels of financial knowledge through ChatGPT, the researchers utilized the nature of financial inquiries directed at artificial intelligence systems. Subsequently, they categorized this knowledge into three tiers, as depicted in **Figure 1**.

1. Normal Financial Knowledge: This is characterized by straightforward and clear awareness that doesn't necessitate extensive contemplation. Decisions can be comfortably reached without delving into deep analysis.
2. Experienced Financial Knowledge: pertains to the intermediate level of familiarity with artificial intelligence systems, enabling effective handling of diverse scenarios to arrive at improved decisions.
3. Profound Financial Knowledge encompasses the adept handling of intricate, indirect issues—those that necessitate thorough analysis and comprehensive comparisons to attain an optimal outcome.

Areiqat, Abu-Rumman, Al-Alani, and Alhorani (2019) underscored that investment decisions are influenced by a multitude of factors, among which the paramount one is investors' opportunity confidence—a pivotal behavioral factor significantly impacting individual investment choices. "Researchers hold differing opinions regarding the study due to the inherent risks associated with individual investment decisions. Conversely, the study by Van den Berg, Slot, van Steenbergen, Faasse, and van Vliet (2019) highlighted that an investment decision's quality hinges on two key aspects: the decisiveness of the choice and the content's excellence. Notably, a decision is deemed high-quality when rooted in financial knowledge. Additionally, findings from another study showed that individuals possessing financial expertise and cultural insight tend to make more informed investment choices (Nurbarani & Soepriyanto, 2022). Furthermore, investment decisions are influenced by various demographic factors, among which overconfidence plays a significant role, intertwined with the realm of behavioral finance.

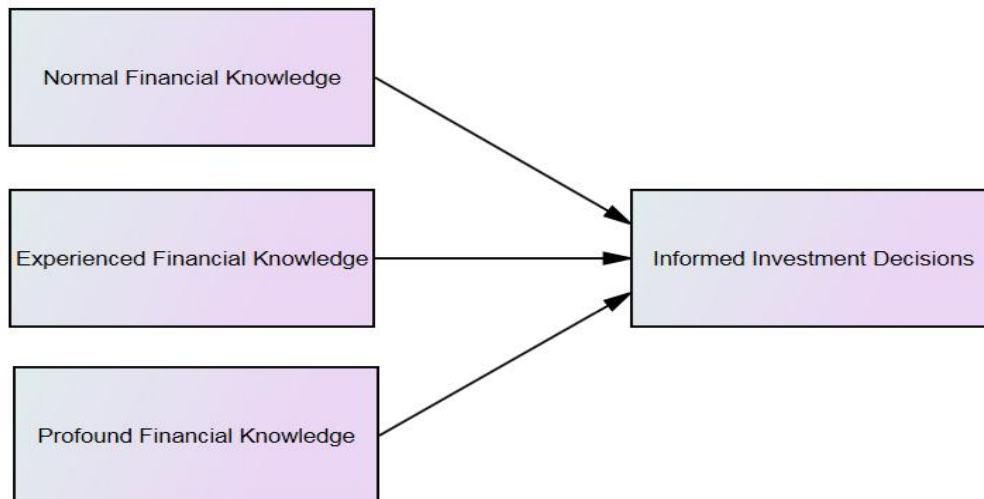


Figure 1. Study Model (Source: compiled by the authors)

METHODOLOGY

Research Type

This research constitutes an empirical study that relies on the case study method, seeking to empirically examine hypotheses concerning the impact of integrating financial knowledge with ChatGPT on the formulation of well-informed investment decisions. The research is meticulously designed to furnish concrete empirical evidence pertaining to the levels of financial expertise—Normal Financial knowledge, Experienced Financial knowledge, and profound Financial knowledge—functioning as independent variables, while discerning their influence on the outcome of informed investment decisions, serving as the dependent variable.

Research Population and Sample

The study population is the artificial intelligence systems, and the sample used in this study is ninety tested cases through the site ChatGPT, using the purposive sampling technique. In this study, the approved sampling criteria were:

1. ChatGPT is one of the widely renowned artificial intelligence systems that have appeared recently.
2. Ease of use and flexibility in the answers provided by ChatGPT.
3. The possibility of ChatGPT dealing with various mathematical and financial tasks.

Data Collection Phase

The data utilized in this study falls under the category of documentary data, primarily sourced from personality tests administered by the researchers. This data was procured directly by posing specific inquiries to ChatGPT on the OpenAI website. The documented records were meticulously organized in a chronological manner, in alignment with the test dates and subject matter (refer to Appendix-1 for detailed records). In addition to the primary data, the study also encompasses secondary data, obtained through comprehensive literature reviews. These reviews provided valuable insights through an assortment of topics. The process of data collection and documentation involved a systematic classification of written material pertaining to the research's focal points. These materials were sourced from diverse mediums including books, scholarly journals, research publications, and other relevant sources.

Data Processing

Subsequent to data collection, a crucial step involves its quantitative processing, a task that demands meticulous precision. Accurate data processing holds paramount significance to prevent any adverse impact on the resultant outcomes. The researchers dedicated their efforts to meticulously process the amassed data, effectively transforming it into actionable and valuable information. This transformation of raw data into comprehensible insights is vividly depicted in **Table 1**.

Table 1. Quantity Data Processing

| Financial knowledge | N | Incorrect answers | Rate | Acceptable Answers | Rate | Correct answers | Rate | Failure Rate |
|---------------------|----|-------------------|------|--------------------|------|-----------------|------|--------------|
| Normal | 30 | 9 | 0.30 | 8 | 0.27 | 13 | 0.43 | 0.57 |
| Experienced | 30 | 7 | 0.23 | 9 | 0.30 | 14 | 0.47 | 0.53 |
| Profound | 30 | 11 | 0.37 | 11 | 0.37 | 8 | 0.27 | 0.73 |

Based on the aforementioned findings, a discernible pattern emerges regarding the failure rates associated with the three distinct categories of financial knowledge. Notably, Experienced Financial knowledge exhibited the highest rate of success in ChatGPT responses, achieving a commendable 47%. Following suit is Normal Financial knowledge. Conversely, profound Financial knowledge encountered the most pronounced rate of failure, standing at 73% (Appendix-2). From these outcomes, a noteworthy observation arises: artificial intelligence systems, particularly ChatGPT, registered a 61% failure rate in effectively addressing financial quandaries. Consequently, the system's capacity to facilitate well-informed investment decisions becomes questionable, casting doubt on its reliability for such purposes.

RESULTS AND DISCUSSION

Descriptive Statistics

The purpose of employing descriptive statistics is to furnish an all-encompassing portrayal of the data. This is vividly demonstrated in **Table 2**, which encapsulates the essential metrics: minimum, maximum, mean, and standard deviation values. These findings stem from the application of a statistical test within the SPSS output. This test delves into the realm of descriptive statistics, examining variables such as Normal Financial knowledge, Experienced Financial knowledge, profound Financial knowledge, and the outcomes of informed investment decisions:

1. The sample consisted of 30 sets, totaling ninety cases.
2. The highest mean value was attributed to Profound Financial knowledge (5.70), while the lowest mean value was associated with informed investment decisions (1.04).
3. In relation to informed investment decisions, the standard deviation was measured at 0.227, whereas the maximum standard deviation of 2.409 was recorded for Profound Financial knowledge.

Table 2. Descriptive Statistics

| | N | Mean | Std. Deviation |
|---------------------------------|----|--------|----------------|
| Normal Financial knowledge | 30 | 2.1333 | .86037 |
| Experienced Financial knowledge | 30 | 4.4667 | 1.63440 |
| Profound Financial knowledge | 30 | 5.7000 | 2.40903 |
| Informed investment decisions | 30 | 1.0444 | .22715 |
| Valid N (listwise) | 30 | | |

Testing Research Hypotheses

Normality Test

A normality test is utilized to ascertain whether a variable within a regression model adheres to a normal distribution. This examination relies on a t-test, presupposing that the test result hinges on the data's distribution. This entails conducting analyses and statistical tests, specifically employing the Kolmogorov-Smirnov test. The conclusive outcomes of this procedure are presented in a clear manner in **Table 3**.

Table 3. Normality Test

| One-Sample Kolmogorov-Smirnov Test | | | |
|---|----------------|--------|--------|
| N | | X | Y |
| | | 30 | 30 |
| Normal Parameters ^{a,b} | Mean | 4.1000 | 1.0444 |
| | Std. Deviation | .97929 | .22715 |
| Most Extreme Differences | Absolute | .106 | .211 |
| | Positive | .106 | .211 |
| | Negative | -.094 | -.156 |
| Kolmogorov-Smirnov Z | | .580 | 1.155 |
| Asymp. Sig. (2-tailed) | | .890 | .139 |

a. Test distribution is Normal
b. Calculated from data

Based on the aforementioned results, it's evident that the Asymp. Sig values for financial knowledge and Informed investment decisions are (0.890 & 0.139) respectively. Given that these values exceed 5%, it can be deduced that the data in the present study adheres to a normal distribution.

Testing of Multicollinearity

To ascertain whether the regression model identifies a correlation among independent variables, a Multicollinearity test is conducted. It's crucial to avoid the presence of a perfect correlation among independent variables. Reviewing the outcomes presented in **Table 4**, it's evident that the variance inflation factor (VIF) values for the three variables are less than 5. Therefore, it can be inferred that no Multicollinearity issue exists among the independent variables.

Table 4. Multicollinearity Test

| Coefficients^a | | | |
|---------------------------------|---------------------------------|-------------------------|-------|
| Model | | Collinearity Statistics | |
| | | Tolerance | VIF |
| 1 | Normal Financial knowledge | .991 | 1.009 |
| | Experienced Financial knowledge | .998 | 1.002 |
| | Profound Financial knowledge | .993 | 1.007 |

a. Dependent Variable: Informed investment decisions

Hypothesis Test

One-way analysis of variance (ANOVA) is a parametric test utilized to compare multiple means within the data. Its purpose is to determine whether significant differences exist among these means, thereby identifying factors contributing to their variations. As per the findings presented in **Table 5**, the second hypothesis is validated, given that the Sig value is less than 0.05. In other words, Experienced Financial knowledge indeed influences informed investment decisions.

Table 5. ANOVA Test

| | | Sum of Squares | df | Mean Square | F | Sig. |
|----|----------------|----------------|----|-------------|-------|------|
| X1 | Between Groups | 7.141 | 5 | 1.428 | 2.393 | .068 |
| | Within Groups | 14.326 | 24 | .597 | | |
| | Total | 21.467 | 29 | | | |
| X2 | Between Groups | 27.673 | 5 | 5.535 | 2.668 | .047 |
| | Within Groups | 49.794 | 24 | 2.075 | | |
| | Total | 77.467 | 29 | | | |
| X3 | Between Groups | 50.823 | 5 | 10.165 | 2.077 | .104 |
| | Within Groups | 117.477 | 24 | 4.895 | | |
| | Total | 168.300 | 29 | | | |

Drawing from the data in **Table 5**, several conclusions can be derived:

1. Partially reject the first hypothesis, given the Sig value exceeding 0.05. This implies that the impact of

Normal Financial knowledge on informed investment decisions lacks significance at the 5% level. However, it retains significance and acceptance at the 10% level.

2. Reject the third hypothesis due to the Sig value surpassing 0.05. This signifies that the influence of Profound Financial knowledge on informed investment decisions isn't statistically significant at the 5% level.

Regression Analysis

Determination Coefficient

The coefficient of determination (R^2) gauges the extent to which the independent variable can account for the fluctuations in the dependent variable. This statistical computation is depicted in **Table 6**. The (R^2) value effectively demonstrates the impact of the independent variable on the dependent variable, with a value of 82.7%. This illustrates that the independent variable (financial knowledge with ChatGPT) contributes approximately 82.7% towards influencing the dependent variable (making informed investment decisions). Meanwhile, the remaining 17.3% is attributed to other variables not encompassed in this research model.

Table 6. Coefficient of Determination

| Model Summary | | | | |
|---------------|-------------------|----------|-------------------|----------------------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .909 ^a | .827 | .821 | .09613 |

a. Predictors: (Constant), Financial knowledge

Reliability Statistic

In statistical terms, reliability signifies the consistency of measurement, reflecting the ability to yield identical outcomes for two tests or, even more, upon repetition. The assessment of reliability hinges on the F-value, which determines whether the independent variable incorporated into the model exerts an impact on the dependent variable. The ensuing outcomes of the F Test are calculated through the utilization of (SPSS) and are detailed in **Table 7**.

Table 7. Reliability Test (F-Statistical)

| ANOVA ^a | | | | | | |
|--------------------|----------------|-------|-------------|-------|---------|-------------------|
| Model | Sum of Squares | df | Mean Square | F | Sig. | |
| 1 | Regression | 1.238 | 1 | 1.238 | 133.923 | .000 ^b |
| | Residual | .259 | 28 | .009 | | |
| | Total | 1.496 | 29 | | | |

a. Dependent Variable: Informed Investment Decisions
b. Predictors: (Constant), Financial Knowledge

From the data presented in the table above, an obtained (F) value of 133.9 was noted. At a 95% confidence level with a significance level (α) of 5%, the critical F-value from the table (F_{Table}) was determined to be 2.40. Since the calculated F-value ($F_{Calculate}$) of 133.9 exceeds the critical value (2.40), the null hypothesis (H_0) is rejected. Consequently, this suggests a significant influence between the integration of financial knowledge with ChatGPT and the process of making informed investment decisions. Furthermore, the calculated (Sig) value is less than 0.05, indicating the acceptance of the fourth hypothesis, signifying the presence of a substantial impact stemming from the amalgamation of financial knowledge with ChatGPT on informed investment decisions.

CONCLUSION

From the results of this study, the following conclusions can be submitted:

1. Financial knowledge with ChatGPT has a significant effect on making informed investment decisions. Specifically, Experienced Financial knowledge. That is, the user must have technological experience and financial knowledge to be able to make an informed decision through ChatGPT.

2. The failure of the artificial intelligence system (OpenAI-ChatGPT) to process some mathematical questions that need intellectual inference and mental reasoning.

3. ChatGPT failed to achieve equal opportunities for users, especially people who need financial literacy. Therefore the inability of all users to make informed investment decisions.

RECOMMENDATIONS

More research is needed to be able to find out more things to influence the making of informed investment decisions through ChatGPT. Including determining the level of knowledge of users. Conducting studies for longer periods so that it can provide better results about Artificial Intelligence Systems. Specifically ChatGPT. We believe the results are likely to be different and best. Developing some aspects of ChatGPT through the possibility of adding mathematical equations and tables, as well as providing users with multiple answer options for every question asked.

DECLARATIONS

Availability of Data and Material

The datasets used and analyzed during the current study are available from the author on request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

All authors read and approved the final manuscript.

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REFERENCES

- Adam, M., Wessel, M., & Benlian, A. (2021). AI-based chatbots in customer service and their effects on user compliance. *Electronic Markets*, 31(2), 427-445.
- Alnefaie, A., Singh, S., Kocaballi, B., & Prasad, M. (2021, January). An overview of conversational agent: Applications, challenges and future directions. In *17th International Conference on Web Information Systems and Technologies* (pp. 388-396). SCITEPRESS-Science and Technology Publications. Retrieved from <https://opus.lib.uts.edu.au/bitstream/10453/153384/2/107086.pdf>
- Areiqat, A. Y., Abu-Rumman, A., Al-Alani, Y. S., & Alhorani, A. (2019). Impact of behavioral finance on stock investment decisions applied study on a sample of investors at Amman stock exchange. *Academy of Accounting and Financial Studies Journal*, 23(2), 1-17.
- Bubeck, S., Chandrasekaran, V., Eldan, R., Gehrke, J., Horvitz, E., Kamar, E., . . . Zhang, Y. (2023). Sparks of artificial general intelligence: Early experiments with GPT-4. <https://doi.org/10.48550/arXiv.2303.12712>
- Hariri, W. (2023). Unlocking the potential of ChatGPT: A comprehensive exploration of its applications, advantages, limitations, and future directions in natural language processing. <https://doi.org/10.48550/arXiv.2304.02017>
- Hoch, C. C., Wollenberg, B., Lüers, J. C., Knoedler, S., Knoedler, L., Frank, K., . . . Alfertshofer, M. (2023). ChatGPT's quiz skills in different otolaryngology subspecialties: An analysis of 2576 single-choice and multiple-choice board certification preparation questions. *European Archives of Oto-Rhino-Laryngology*, 1-8.
- Indriaswari, I., Ulupui, I. G. K. A., & Warokka, A. (2022). Financial knowledge, financial attitude, and locus of control: Reviewing their influence on financial management behavior using financial literacy as moderation variable. *The International Journal of Social Sciences World (TIJOSSW)*, 4(2), 431-443.
- Lim, W. M., Kumar, S., Verma, S., & Chaturvedi, R. (2022). Alexa, what do we know about conversational commerce? Insights from a systematic literature review. *Psychology & Marketing*, 39(6), 1129-1155.
- Lind, T., Ahmed, A., Skagerlund, K., Strömbäck, C., Västfjäll, D., & Tinghög, G. (2020). Competence, confidence, and gender: The role of objective and subjective financial knowledge in household finance. *Journal of Family and Economic Issues*, 41, 626-638.
- Nurbarani, B. S., & Soepriyanto, G. (2022). Determinants of investment decision in cryptocurrency: Evidence from Indonesian investors. *Universal Journal of Accounting and Finance*, 10(1), 254-266.
- Panjaitan, H. P., Renaldo, N., & Suyono. (2022). The Influence of financial knowledge on financial behavior and financial satisfaction on Pelita Indonesia students. *Jurnal Manajemen Indonesia*, 22(2), 145-153.
- Rachapaettayakom, P., Wiriyapinit, M., Cooharajanone, N., Tanthanongsakkun, S., & Charoenruk, N. (2020). The need for financial knowledge acquisition tools and technology by small business entrepreneurs. *Journal of Innovation and Entrepreneurship*, 9, 1-28.
- Sahara, Y., Fuad, M., & Setianingsih, D. (2022). The role of financial attitude, financial experience, financial knowledge and personality on student's personal financial management behavior. *SOROT*, 17(3), 167-176.
- Salas-Pilco, S. Z., & Yang, Y. (2022). Artificial intelligence applications in Latin American higher education: A systematic review. *International Journal of Educational Technology in Higher Education*, 19(1), 1-20.
- Shahriar, S., & Hayawi, K. (2023). Let's have a chat! A conversation with ChatGPT: Technology, applications, and limitations. <https://doi.org/10.48550/arXiv.2302.13817>
- Sidor, V. L., & Manate, D. (2023). Financial education among adults in Romania. *Journal of Financial Studies*, 8(14), 165-180.
- Susnjak, T. (2023). Beyond predictive learning analytics modelling and onto explainable artificial intelligence with prescriptive analytics and ChatGPT. *International Journal of Artificial Intelligence in Education*, 1-31.
- Van den Berg, M., Slot, R., van Steenberg, M., Faasse, P., & van Vliet, H. (2019). How enterprise architecture improves the quality of IT investment decisions. *Journal of Systems and Software*, 152, 134-150.
- Wahyuniati, H., Ibnu, H., & Jumadania, W. (2022). The effect of religiosity and financial knowledge on personal financial distress. *Russian Journal of Agricultural and Socio-Economic Sciences*, 11(131), 224-233.
- Yue, T., Au, D., Au, C. C., & Iu, K. Y. (2023). Democratizing financial knowledge with ChatGPT by OpenAI: Unleashing the Power of Technology. <http://dx.doi.org/10.2139/ssrn.4346152>

Appendix-1

Artificial Intelligence Systems Tests (OpenAI - ChatGPT)

| Case No | Case topic | Test date |
|----------------|--------------------------------------|------------------|
| Case 1 | Beta Calculation | 08/07/2023 |
| Case 2 | Treynor and Sharpe Analysis | 08/07/2023 |
| Case 3 | Investment Ending Value Factors | 08/07/2023 |
| Case 4 | IPS Importance | 10/07/2023 |
| Case 5 | Growth PV Calculation | 10/07/2023 |
| Case 6 | Short-Term Assets & Liabilities | 10/07/2023 |
| Case 7 | Calculating Financial Statistics. | 10/07/2023 |
| Case 8 | High-Yield Bond Analysis Differences | 10/07/2023 |
| Case 9 | Stock Split Adjustments | 10/07/2023 |
| Case 10 | Risk-Free Bond | 10/07/2023 |
| Case 11 | Call Option Price Calculation | 11/07/2023 |
| Case 12 | Exchange Rate Conversion | 11/07/2023 |
| Case 13 | Leverage, ROI and Risk. | 11/07/2023 |
| Case 14 | NPV Calculation | 11/07/2023 |
| Case 15 | Present Value Calculation | 11/07/2023 |
| Case 16 | WACC Calculation | 11/07/2023 |
| Case 17 | Risk of Financial Leverage | 11/07/2023 |
| Case 18 | Estimate Variance | 11/07/2023 |
| Case 19 | Missing Duration for Cash Flow | 11/07/2023 |
| Case 20 | Cost of combined options | 11/07/2023 |
| Case 21 | Gap and Requirement | 12/07/2023 |
| Case 22 | Swap Notional Size | 12/07/2023 |
| Case 23 | Current Treasury Rates | 12/07/2023 |
| Case 24 | Option Delta Explained | 12/07/2023 |
| Case 25 | Operational Risk Sources | 12/07/2023 |
| Case 26 | Forward Contract Explanation | 12/07/2023 |
| Case 27 | Bank Regulations | 12/07/2023 |
| Case 28 | Z Score Default Risk | 12/07/2023 |
| Case 29 | Loan Commitment Return | 12/07/2023 |
| Case 30 | Bond Option Valuation Models | 12/07/2023 |
| Case 31 | Assumptions Modified Economic Theory | 13/07/2023 |
| Case 32 | Capital Allocation Tools | 13/07/2023 |
| Case 33 | EPS | 13/07/2023 |
| Case 34 | ROA, ROE, ROIC Calculations | 13/07/2023 |
| Case 35 | Factors Influencing Cost of Money | 13/07/2023 |
| Case 36 | Interest Rates | 13/07/2023 |
| Case 37 | Stock Market Equilibrium | 13/07/2023 |
| Case 38 | CAPM | 13/07/2023 |
| Case 39 | Bond Investors' Concerns | 13/07/2023 |
| Case 40 | Models: DDM & DCF | 13/07/2023 |
| Case 41 | Stock Price with Growth Rates | 13/07/2023 |
| Case 42 | ROE & Dividend Growth | 13/07/2023 |
| Case 43 | WACC Factors | 13/07/2023 |
| Case 44 | ROIC & ROE | 13/07/2023 |
| Case 45 | Interest and Effective Rate | 13/07/2023 |
| Case 46 | Financial Planning Steps | 13/07/2023 |
| Case 47 | Cost-conscious sales growth | 13/07/2023 |
| Case 48 | Sales Growth Strategies | 13/07/2023 |
| Case 49 | Global Expansion Reasons | 13/07/2023 |
| Case 50 | Major International Credit Markets | 13/07/2023 |
| Case 51 | CD Interest Calculation | 14/07/2023 |
| Case 52 | Growth Rate Calculation | 14/07/2023 |
| Case 53 | Interest Payment and Annual Rate | 14/07/2023 |
| Case 54 | NPV Calculation with WACC | 14/07/2023 |
| Case 55 | Required return for Fund P | 14/07/2023 |

| Case No | Case topic | Test date |
|----------------|------------------------------------|------------------|
| Case 56 | Required Rate of Return | 14/07/2023 |
| Case 57 | Dividends | 14/07/2023 |
| Case 58 | Beta and Cost of Equity | 14/07/2023 |
| Case 59 | Risk-Adjusted Cost of Capital | 14/07/2023 |
| Case 60 | Target Cash Balance | 14/07/2023 |
| Case 61 | AFN Calculation for Carlsbad | 14/07/2023 |
| Case 62 | Complete Financial Data | 14/07/2023 |
| Case 63 | Cost of Equity Models | 14/07/2023 |
| Case 64 | Stock Split | 14/07/2023 |
| Case 65 | Dividend Payout Ratio | 14/07/2023 |
| Case 66 | Investment Banks | 14/07/2023 |
| Case 67 | YTM: Find Required Rate | 14/07/2023 |
| Case 68 | Payback Measures | 14/07/2023 |
| Case 69 | Dividend's Impact on Growth | 14/07/2023 |
| Case 70 | Dividend Variation in Large Corps | 14/07/2023 |
| Case 71 | Bank Ratios | 15/07/2023 |
| Case 72 | Central Bank Independence | 15/07/2023 |
| Case 73 | CP Payment Calculation | 15/07/2023 |
| Case 74 | Bond Price Calculation | 15/07/2023 |
| Case 75 | Monetary Policy | 15/07/2023 |
| Case 76 | Expected Return | 15/07/2023 |
| Case 77 | Financial Markets | 15/07/2023 |
| Case 78 | Bond Yield Estimation | 15/07/2023 |
| Case 79 | Liability Management | 15/07/2023 |
| Case 80 | Symmetric Problems | 15/07/2023 |
| Case 81 | Taxable vs Tax-Free Bonds | 15/07/2023 |
| Case 82 | ROE vs ROA | 15/07/2023 |
| Case 83 | Indirect Finance | 15/07/2023 |
| Case 84 | Issuer Advantages | 15/07/2023 |
| Case 85 | Change in Portfolio Value | 15/07/2023 |
| Case 86 | Behavioral Finance and Efficiency | 15/07/2023 |
| Case 87 | PV of 6-Year Zero-Coupon Bond | 15/07/2023 |
| Case 88 | Treasury Bill Discount Calculation | 15/07/2023 |
| Case 89 | Credit Market Instruments | 15/07/2023 |
| Case 90 | Real Interest Rates | 15/07/2023 |

Appendix-2

Case Test Results

| Case No | Financial knowledge type | Test result |
|----------------|---------------------------------|--------------------|
| Case 1 | Experienced Financial Knowledge | Correct answer |
| Case 2 | Profound Financial Knowledge | Acceptable answer |
| Case 3 | Normal Financial knowledge | Correct answer |
| Case 4 | Experienced Financial Knowledge | Correct answer |
| Case 5 | Profound Financial Knowledge | Acceptable answer |
| Case 6 | Normal Financial knowledge | Correct answer |
| Case 7 | Profound Financial Knowledge | Incorrect answer |
| Case 8 | Experienced Financial Knowledge | Acceptable answer |
| Case 9 | Normal Financial knowledge | Correct answer |
| Case 10 | Normal Financial knowledge | Correct answer |
| Case 11 | Profound Financial Knowledge | Correct answer |
| Case 12 | Experienced Financial Knowledge | Correct answer |
| Case 13 | Profound Financial Knowledge | Incorrect answer |
| Case 14 | Normal Financial knowledge | Acceptable answer |
| Case 15 | Normal Financial knowledge | Correct answer |
| Case 16 | Experienced Financial Knowledge | Incorrect answer |
| Case 17 | Normal Financial knowledge | Correct answer |
| Case 18 | Normal Financial knowledge | Incorrect answer |
| Case 19 | Experienced Financial Knowledge | Incorrect answer |
| Case 20 | Profound Financial Knowledge | Incorrect answer |
| Case 21 | Normal Financial knowledge | Incorrect answer |
| Case 22 | Experienced Financial Knowledge | Incorrect answer |
| Case 23 | Profound Financial Knowledge | Incorrect answer |
| Case 24 | Normal Financial knowledge | Correct answer |
| Case 25 | Experienced Financial Knowledge | Acceptable answer |
| Case 26 | Normal Financial knowledge | Incorrect answer |
| Case 27 | Normal Financial knowledge | Correct answer |
| Case 28 | Experienced Financial Knowledge | Correct answer |
| Case 29 | Profound Financial Knowledge | Incorrect answer |
| Case 30 | Profound Financial Knowledge | Correct answer |
| Case 31 | Normal Financial knowledge | Incorrect answer |
| Case 32 | Experienced Financial Knowledge | Acceptable answer |
| Case 33 | Profound Financial Knowledge | Acceptable answer |
| Case 34 | Profound Financial Knowledge | Acceptable answer |
| Case 35 | Experienced Financial Knowledge | Acceptable answer |
| Case 36 | Experienced Financial Knowledge | Acceptable answer |
| Case 37 | Profound Financial Knowledge | Incorrect answer |
| Case 38 | Profound Financial Knowledge | Correct answer |
| Case 39 | Experienced Financial Knowledge | Acceptable answer |
| Case 40 | Normal Financial knowledge | Acceptable answer |
| Case 41 | Experienced Financial Knowledge | Incorrect answer |
| Case 42 | Normal Financial knowledge | Incorrect answer |
| Case 43 | Normal Financial knowledge | Acceptable answer |
| Case 44 | Experienced Financial Knowledge | Incorrect answer |
| Case 45 | Profound Financial Knowledge | Correct answer |
| Case 46 | Profound Financial Knowledge | Acceptable answer |
| Case 47 | Profound Financial Knowledge | Acceptable answer |
| Case 48 | Experienced Financial Knowledge | Acceptable answer |
| Case 49 | Normal Financial knowledge | Acceptable answer |
| Case 50 | Experienced Financial Knowledge | Correct answer |
| Case 51 | Normal Financial knowledge | Correct answer |
| Case 52 | Normal Financial knowledge | Incorrect answer |
| Case 53 | Experienced Financial Knowledge | Correct answer |
| Case 54 | Profound Financial Knowledge | Incorrect answer |
| Case 55 | Profound Financial Knowledge | Acceptable answer |

| Case No | Financial knowledge type | Test result |
|----------------|---------------------------------|--------------------|
| Case 56 | Experienced Financial Knowledge | Correct answer |
| Case 57 | Normal Financial knowledge | Incorrect answer |
| Case 58 | Profound Financial Knowledge | Acceptable answer |
| Case 59 | Experienced Financial Knowledge | Correct answer |
| Case 60 | Experienced Financial Knowledge | Correct answer |
| Case 61 | Profound Financial Knowledge | Incorrect answer |
| Case 62 | Profound Financial Knowledge | Acceptable answer |
| Case 63 | Experienced Financial Knowledge | Acceptable answer |
| Case 64 | Experienced Financial Knowledge | Correct answer |
| Case 65 | Normal Financial knowledge | Incorrect answer |
| Case 66 | Normal Financial knowledge | Correct answer |
| Case 67 | Profound Financial Knowledge | Acceptable answer |
| Case 68 | Experienced Financial Knowledge | Correct answer |
| Case 69 | Normal Financial knowledge | Correct answer |
| Case 70 | Normal Financial knowledge | Acceptable answer |
| Case 71 | Profound Financial Knowledge | Correct answer |
| Case 72 | Normal Financial knowledge | Acceptable answer |
| Case 73 | Profound Financial Knowledge | Correct answer |
| Case 74 | Experienced Financial Knowledge | Incorrect answer |
| Case 75 | Experienced Financial Knowledge | Acceptable answer |
| Case 76 | Normal Financial knowledge | Incorrect answer |
| Case 77 | Normal Financial knowledge | Acceptable answer |
| Case 78 | Experienced Financial Knowledge | Correct answer |
| Case 79 | Normal Financial knowledge | Correct answer |
| Case 80 | Experienced Financial Knowledge | Correct answer |
| Case 81 | Profound Financial Knowledge | Correct answer |
| Case 82 | Experienced Financial Knowledge | Incorrect answer |
| Case 83 | Experienced Financial Knowledge | Correct answer |
| Case 84 | Profound Financial Knowledge | Acceptable answer |
| Case 85 | Profound Financial Knowledge | Incorrect answer |
| Case 86 | Normal Financial knowledge | Correct answer |
| Case 87 | Profound Financial Knowledge | Incorrect answer |
| Case 88 | Profound Financial Knowledge | Correct answer |
| Case 89 | Normal Financial knowledge | Acceptable answer |
| Case 90 | Profound Financial Knowledge | Incorrect answer |

Appendix-3

Quantitative Data for the Study

| No | Financial knowledge | Test result | Informed decisions | No | Financial knowledge | Test result | Informed decisions | No | Financial knowledge | Test result | Informed decisions |
|---------|---------------------|-------------|--------------------|---------|---------------------|-------------|--------------------|---------|---------------------|-------------|--------------------|
| Case 1 | 2 | 3 | 1.5 | Case 31 | 1 | 1 | 0.5 | Case 61 | 3 | 1 | 0.5 |
| Case 2 | 3 | 2 | 1 | Case 32 | 2 | 2 | 1 | Case 62 | 3 | 2 | 1 |
| Case 3 | 1 | 3 | 1.5 | Case 33 | 3 | 2 | 1 | Case 63 | 2 | 2 | 1 |
| Case 4 | 2 | 3 | 1.5 | Case 34 | 3 | 2 | 1 | Case 64 | 2 | 3 | 1.5 |
| Case 5 | 3 | 2 | 1 | Case 35 | 2 | 2 | 1 | Case 65 | 1 | 1 | 0.5 |
| Case 6 | 1 | 3 | 1.5 | Case 36 | 2 | 2 | 1 | Case 66 | 1 | 3 | 1.5 |
| Case 7 | 3 | 1 | 0.5 | Case 37 | 3 | 1 | 0.5 | Case 67 | 3 | 2 | 1 |
| Case 8 | 2 | 2 | 1 | Case 38 | 3 | 3 | 1.5 | Case 68 | 2 | 3 | 1.5 |
| Case 9 | 1 | 3 | 1.5 | Case 39 | 2 | 2 | 1 | Case 69 | 1 | 3 | 1.5 |
| Case 10 | 1 | 3 | 1.5 | Case 40 | 1 | 2 | 1 | Case 70 | 1 | 2 | 1 |
| Case 11 | 3 | 3 | 1.5 | Case 41 | 2 | 1 | 0.5 | Case 71 | 3 | 3 | 1.5 |
| Case 12 | 2 | 3 | 1.5 | Case 42 | 1 | 1 | 0.5 | Case 72 | 1 | 2 | 1 |
| Case 13 | 3 | 1 | 0.5 | Case 43 | 1 | 2 | 1 | Case 73 | 3 | 3 | 1.5 |
| Case 14 | 1 | 2 | 1 | Case 44 | 2 | 1 | 0.5 | Case 74 | 2 | 1 | 0.5 |
| Case 15 | 1 | 3 | 1.5 | Case 45 | 3 | 3 | 1.5 | Case 75 | 2 | 2 | 1 |
| Case 16 | 2 | 1 | 0.5 | Case 46 | 3 | 2 | 1 | Case 76 | 1 | 1 | 0.5 |
| Case 17 | 1 | 3 | 1.5 | Case 47 | 3 | 2 | 1 | Case 77 | 1 | 2 | 1 |
| Case 18 | 1 | 1 | 0.5 | Case 48 | 2 | 2 | 1 | Case 78 | 2 | 3 | 1.5 |
| Case 19 | 2 | 1 | 0.5 | Case 49 | 1 | 2 | 1 | Case 79 | 1 | 3 | 1.5 |
| Case 20 | 3 | 1 | 0.5 | Case 50 | 2 | 3 | 1.5 | Case 80 | 2 | 3 | 1.5 |
| Case 21 | 1 | 1 | 0.5 | Case 51 | 1 | 3 | 1.5 | Case 81 | 3 | 3 | 1.5 |
| Case 22 | 2 | 1 | 0.5 | Case 52 | 1 | 1 | 0.5 | Case 82 | 2 | 1 | 0.5 |
| Case 23 | 3 | 1 | 0.5 | Case 53 | 2 | 3 | 1.5 | Case 83 | 2 | 3 | 1.5 |
| Case 24 | 1 | 3 | 1.5 | Case 54 | 3 | 1 | 0.5 | Case 84 | 3 | 2 | 1 |
| Case 25 | 2 | 2 | 1 | Case 55 | 3 | 2 | 1 | Case 85 | 3 | 1 | 0.5 |
| Case 26 | 1 | 1 | 0.5 | Case 56 | 2 | 3 | 1.5 | Case 86 | 1 | 3 | 1.5 |
| Case 27 | 1 | 3 | 1.5 | Case 57 | 1 | 1 | 0.5 | Case 87 | 3 | 1 | 0.5 |
| Case 28 | 2 | 3 | 1.5 | Case 58 | 3 | 2 | 1 | Case 88 | 3 | 3 | 1.5 |
| Case 29 | 3 | 1 | 0.5 | Case 59 | 2 | 3 | 1.5 | Case 89 | 1 | 2 | 1 |
| Case 30 | 3 | 3 | 1.5 | Case 60 | 2 | 3 | 1.5 | Case 90 | 3 | 1 | 0.5 |

Note: The criteria approved by researchers to process data mathematically in this study are:

1. Giving values for the type of financial knowledge from (1) Normal Financial knowledge, (2) Experienced Financial Knowledge, and (3) Profound Financial Knowledge.
2. Values of Test results from (1) Incorrect result, (2) Somewhat correct result, and (3) Exactly correct result.
3. Informed investment decisions are calculated by the following equation:

$$\text{Informed investment decisions} = \frac{\text{Test Results}_c}{3!} \times 3$$

4. Equation results for informed investment decisions from (0.50) Uninformed decision, (1) Somewhat Informed decision, and (1.5) Informed decision.