# Effect of Tasks Complexity and Visualization on Investment Decision-Making

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**ABSTRACT**

*This study examines the differences in investment decision-making, as measured by the accuracy, confidence, and calibration levels of investment decisions between participants who receive tasks with different levels of complexity and information visualization. It involved a laboratory experiment among accounting students who had taken or were taking courses in Financial Statement Analysis and Investment and Capital Market Management. The final sample comprised 172 participants who passed the manipulation check and the general accounting knowledge test. A 2 × 2 (within subject) experimental design was used for the analysis: task complexity (high and low) and information visualization (high and low). The results indicate that for nonprofessional investors, the complexity of the task has the most effect on investment decision-making compared to information visualization. Nonprofessional investors obtain information with high visualization, tasks with high complexity can reduce the level of accuracy, trust, and calibration in their decision-making. This is because a nonprofessional investor is more focused on the difficulty of the assignments that must be resolved, and thus, even a high level of information visualization does not help in investment decision-making.*

## 1. INTRODUCTION

All companies carry out investment activities to develop and advance their firms. It involves a capital investment activity over a certain period, carried out directly or indirectly, which is expected to provide high returns for the company. Information is the most important factor for investors to consider before investing. In Indonesia, the information needs of investors are fulfilled through financial reports disclosed by companies listed on the Indonesia Stock Exchange (IDX). This includes information such as financial performance summary, management analysis and discussion, stock information, and corporate governance and corporate social responsibility reports. Accounting information constitutes the most important information required by investors and has a strong influence on decision-making. The cognitive processes underlying investors' decision-making depend on the acquired information. The higher the information level obtained by the investors, the more effective will be the decision of the consideration level to be made by investors.

Table 1 *Companies in the Sub-sectors of the Basic and Chemical Industry*

| Company name | Number of tables | Number of Infographics |
|---|---|---|
| PT Aneka Gas Industri Tbk | 205 | 9 |
| PT Barito Pasific Tbk | 199 | 6 |
| PT Budi Starch & Sweetener Tbk | 92 | 6 |
| PT Ekadharma International Tbk | 80 | 1 |
| PT Eterindo Wahanatama Tbk | 110 | 10 |
| PT Intan Wijaya International Tbk | 104 | 16 |
| PT Emdeki Utama Tbk | 152 | 7 |
| PT Indo Acitama Tbk | 93 | 6 |
| PT Chandra Asri Petrochecimal Tbk | 168 | 3 |
| PT Unggul Indah Cahaya Tbk | 120 | 7 |

*Note*: Based on author's calculations



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Table 1 presents the manufacturing companies in basic and chemical industry sub-sectors that present information in tables and graphs in their annual reports. Previously, we have conducted reviews of all the companies in the basic and chemical industry sub-sectors that provide information in tables and graphs for their annual report. The information presented in a tabular format includes (1) Financial Summary, which consists of income statement, financial position statement, and ratio analysis; (2) Stock Information, which describes all of the company's shares traded on the regular market during a certain period; (3) Human Resources, which describes the improvement of employee capability, maintenance, and welfare services for all employees, technically, functionally, and managerially; and (4) Management Discussion Analysis, which consists of an analysis of financial performance, business prospects, and dividend policy. Meanwhile, the information presented graphically involves financial summary and stock information only.

Information visualization or information presented in tables or graphs consists of concise illustrations that can improve decision-making efficiency by enabling faster and more accurate comprehension and management of information without experiencing information overload or a lack of information, leading to right decisions being taken by an investor. The method of information presentation influences the decision-making process. The easier the information is to understand, the higher the confidence level of an investor in the decision being made. By making the right decision, the investor obtains an optimal investment decision. The right decision is one taken in accordance with the effect of events on the company's value (Puspitaningtyas, 2013).

Some studies have examined the factors influencing decision-making. Utami and Nahartyo (2016) examined the impact of interactive reviews and the effectiveness of group support systems (GSS) in mitigating information ambiguity in audit decisions. They showed that the more ambiguous a set of presented information is, the more inaccurate the audit decision; moreover, GSS-based interactive reviews were found to increase the accuracy of audit decisions. Rokhayati et al. (2019) examined the effect of financial information and corporate social responsibility (CSR) disclosure on investment decisions, revealing that CSR disclosure affects investment decisions.

Dilla et al. (2013) showed that in investment decision-making, nonprofessional investors are influenced by information in graphical form, whereas professional investors are not influenced by it. Tang et al. (2014) provided evidence that a set of information that has a high visualization level or interaction level can reduce the performance of investment decision-making, while a comprehensive, visual, and interactive multimedia tool can improve investment decision-making performance. Their results showed that the visualization effect in decision-making has an effect only when decision makers receive tasks with low task complexity. They also indicated that the effect of task complexity influences decision-making, as measured by the accuracy level, confidence level, and calibration level (Almilia et al., 2019).

This study aims to determine whether there are differences in the levels of accuracy, confidence, and calibration in investment decisions between the participants who receive tasks with high or low complexity and high information visualization and those who receive tasks with high or low complexity and low information visualization. It also investigates the calibration levels between the participants who receive tasks with high complexity and high or low information visualization and those who receive tasks with low complexity and high or low information visualization. This study involved 172 undergraduate accounting students at a private university in Surabaya who had knowledge in the fields of financial statement analysis and investment and capital market management.

## 2. REVIEW THEORY AND DEVELOP HYPOTHESES

### 2.1 Decision Support Systems Design Theory and Dual Coding Theory

The effect of visualization and interactivity on decision-making is known as the decision support systems design theory, which was developed by Kasper (1996). This theory aims to design a decision support system so that a person's confidence level in making decisions reaches perfect calibration. This theory also states that decision-making is determined by the description of symbolic representations (including visibility) and the act of inquiry. Visibility is the ability of a system to help users visualize the data they receive.

The dual coding theory developed by Paivio (1986) shows that there are two types of information processing systems, namely, verbal and visual systems. If verbal and visual systems are activated on the same object, both systems can have an additional effect on individual memory and understanding, namely that of improving individual performance in decision making (Paivio, 1991). Information users who receive information with a high visualization level are expected to perform well at the level of investment decision making.

Almilia, Dewi and Wulanditya (2019) examined the influence of visualization factors and task complexity in investment decisions. Their results showed that decision makers complete tasks with high complexity, and there is no difference in the average calibration level in decision makers who receive information with a high visualization level compared to the average calibration level in decision makers who receive information with a low visualization level. However, when decision makers complete tasks with low complexity, the average calibration level of decision makers who receive information with a high visualization level is higher than the average calibration level of decision makers who receive information with a low visualization level. They also showed that there are significant differences in the average accuracy level, confidence level, and calibration level of decision makers who receive tasks with low complexity compared to decision makers who receive tasks with high complexity. Moreover, the effect of visualization in decision making was found to be influential only when decision makers receive tasks with low complexity. The results of this study indicate that the effect of task complexity influences decision-making, as measured by the level of accuracy, confidence, and calibration.

Almilia, Wulanditya and Nita (2018) examined the effect of the investment decision frame and the belief-adjustment model on investment decision making. Their results showed that there are no differences in responses between participants who receive accounting information (financial decision frames) and participants who receive non-accounting information (expressive decision frames) in the end-of-sequence presentation pattern. However, there is a different response when participants receiving accounting information are compared to those who receive non-accounting information in a step-by-step presentation pattern.

Hanafi (2017) examined the influence of belief-adjustment models and framing effects on investment decision-making for nonprofessional investors. Their results showed that there are differences in decision-making between participants who receive information in the sequence of good news followed by bad news and those who receive bad news followed by good news in the step-by-step presentation pattern, with the framing effects condition in accordance with the information. Additionally, there are differences in decision-making between these two groups of participants in the step-by-step presentation pattern, with the framing of effect information is reversed.

Nisa, (2017) examined the valuation of different investors by using a belief adjustment model to consider presentation patterns, information sequences, and information types. The results showed that recency effect occurs in the step-by-step information pattern and the accounting and non-accounting information types. The recency effect also occurs in the end-

of-sequence information pattern and accounting information type, whereas there is no order effect on non-accounting information type.

Rofiyah & Almilia, (2017) examined the effect of a belief adjustment model consisting of a presentation pattern (step-by-step and end-of-sequence), information sequence (good news followed by bad news or bad news followed by good news), and information series (long and short) on investment decision-making. The results showed that there is a novelty effect on the step-by-step information pattern for long and short information series, whereas the end-of-sequence presentation pattern shows that no novelty effect occurs in the long information series. However, there is a novelty effect that occurs in the short information series.

Astania & Almilia (2017) examined whether there are differences in investment decisions between participants who receive information in the sequence of good news followed by bad news compared to participants who receive information in the sequence of bad news followed by good news in the end-of-sequence presentation pattern and long information series. Their results showed that there are no significant differences in participants who receive information in the sequence of good news followed by bad news compared to participants who received information in the sequence of bad news followed by good news, and there is no order effect in investment decision making.

Almilia & Wulanditya (2016) aimed to examine the influence of overconfidence and experience that can increase or reduce the order effect in investment decision-making. Their results reveal that (1) research subjects who have the nature of overconfidence tend not to experience the order (order effect) when receiving information in the step-by-step presentation pattern, and (2) research subjects who have the nature of overconfidence experience the order (order effect) when receiving information with the end-of-sequence presentation pattern.

Kusumawardhani & Almilia (2015) examined the differences in investment decision-making between participants who were provided good news followed by bad news, and those who were presented bad news followed by good news in the step-by-step presentation pattern and long information series. The results showed no difference in the decision-making of these two groups of participants.

Pravitasari & Almilia, (2015) examined whether there are differences in investment decisions between participants who receive good news followed by bad news and those who receive information in the sequence of bad news followed by good news in the end-of-sequence presentation pattern and short information series. The results showed that there are significant differences in the final judgment of participants who receive information delivered in the sequence of good news followed by bad news compared to participants who receive information in the sequence of bad news followed by good news, and there is a recency effect that occurs in making investment decisions.

Ayuananda & Utami, (2015) examined the recency effect on the sequence, presentation, and types of information on audit decision making when the information is presented sequentially or simultaneously. They reported a recency effect on SPI decisions when the information is presented in a sequential pattern and there is a recency effect in the form of a chart on audit decision making.

Almilia, (2013) investigated the existence of the belief adjustment model, developed by Hogarth and Einhorn (1992), in the context of investment decisions. The study tested the anchor (prior beliefs) in investment decision-making, the usefulness of accounting and non-accounting information, and the differences in the confidence level that can cause the emergence of differences in interpreting and processing information, so as to produce different predictive performance. The results showed that the revised belief model of Hogarth and Einhorn (1992) partially holds in investment decision making.

The predictions of this revised belief model that are not supported in this study are as

follows. First, this study does not succeed in supporting the hypothesis that the end-of-sequence presentation pattern will cause primacy and recency effects when receiving both simple and complex information. Second, this study fails to support the hypothesis that the same good news has a greater influence on low anchors than on high anchors. The results of this study also indicate that information complexity influences investment decision-making.

Almilia & Supriyadi, (2013) examined order effects and the effect of mode response (Step by Step and End of Sequence) or the belief adjustment model in investment decision-making. The results of a study conducted by Almilia & Supriyadi, (2013) show that there are differences in investment decision-making between the investors who receive the direction or sequence of good news followed by bad news and those who receive the direction or sequence of bad news followed by good news in the step-by-step presentation pattern. There is no difference in the end-of-sequence presentation pattern so that there is no order effect between the investors who receive good news followed by bad news and those who receive bad news followed by good news. Ultimately, the recency effect will not occur in the end-of-sequence information presentation pattern.

### 2.2 The Effects of Task Complexity on Investment Decision Making

Task complexity influences accuracy level, confidence level, and calibration level; thus, it is an important factor in decision making. According to Efklides, (2008), confidence level in decisions is influenced by two main information types: estimation of the correct answer and difficulty level of the task. If an individual feels that the given task has a high complexity level, it will reduce the confidence level in the answers.

Tang et al. (2014) stated that information users can see the raw data presented in two different formats: numerical tables and graphic charts. The information contained in the graph activates the imaging system, while the information represented in the numerical table activates the verbal system; thus, it is directed at deeper information installation and increasing understanding. The results of the study also supported the double coding of information, thereby improving verification and decision-making performance. Mayer and Anderson (1991) showed that information that is presented both visually and verbally leads to better performance than the compilation of visual and verbal information that is provided by itself.

H1a: Decision makers who complete tasks with high or low complexity and with high information visualization have a higher level of decision-making accuracy compared to decision makers who complete tasks in high or low complexity and with low information visualization.

H1b: Decision makers who complete tasks in high or low complexity and with high information visualization have a higher level of decision-making confidence compared to decision makers who complete tasks in high or low complexity and with low information visualization.

H1c: Decision makers who complete tasks in high or low complexity and with high information visualization have a higher level of decision-making calibration compared to decision makers who complete tasks in high or low complexity and with low information visualization.

### 2.3. The Effects of Visualization on Investment Decision Making

Lurie & Mason, (2007) state that visualization is the selection, disclosure, or presentation of data using visual forms (pictures, tables, and graphs) to help individuals explore and understand decision-making. In this study, the information presented with high visualization refers to information in the form of graphs or figures and tables, while the information presented with low visualization refers to the information in

textual form, such as tables. High visualization is expected to improve accuracy and performance in decision-making based on dual coding theory.

Visualization can also affect the user's perception of the quality of information, and the quality of information also increases the user's confidence. Visualization activates the verbal handling and imaging system and improves information retention; more concrete information is available in memory for later retrieval. Intelligence research shows that people regard memory accessibility as a sign of quality information, and are more compatible with information that is easily retrieved. Tang et al. (2014) showed that interactivity can improve decision quality, and empirical research has shown how interactive features can improve information, facilitate learning processes, and facilitate better understanding of information created. Almilia et al. (2012) showed that when decision makers receive assignments with low complexity, those who obtain information with a high visualization format have a high level of calibration (accuracy and belief) compared to those who obtain information with a low visualization format.

H2: Decision makers who receive information with high visualization have a high calibration level (accuracy and confidence) compared to decision makers who have information with low visualization.

## 3. RESEARCH METHOD

### 3.1 Research Subjects

The participants in this study were students of the Undergraduate Accounting Department of STIE Perbanas Surabaya, possessing knowledge in financial statement analysis and investment and capital markets management. Therefore, the criteria for the participants in this study were that they should be undergraduate accounting students of STIE Perbanas Surabaya who had taken or were taking the courses of Financial Report Analysis and Investment and Capital Market Management. There were 188 participants in the experiment, but 16 participants did not pass the manipulation check and general accounting knowledge test. Thus, the total number of participants whose data could be further analyzed was 172. These participants were categorized into four groups, each comprising 43 participants, who received tasks with the following attributes: high complexity and high visualization, low complexity and low visualization, high complexity and low visualization, and low complexity and high visualization.

### 3.2 Experiment Design

This study employs the experimental research method. It is used for testing the causal relationship between two or more variables that are subject to control, manipulation, or treatment by researchers who seek to answer a certain problem using empirical data. The experimental design of this study was a 2 × 2 (within subject) design, involving task complexity (high and low) and information visualization (high and low).

### 3.3 Experiment Procedure

The participants who received tasks with high complexity were given seven questions with comparisons between years and between companies. Participants who received tasks with low complexity were given 11 questions with comparisons between years or between companies. In every question, participants were required to fill in the confidence level in the answers that had been given. High visualization refers to information presentation in tables and graphs, while low visualization involves information presentation in a tabular form only.

### 3.4 Research Variables

The independent variables in this study are task complexity (high and low) and information visualization (high and low). The dependent variable is investment decision-making, which was measured by the accuracy level (the total number of correct answers divided by the total number of questions), confidence level (the average confidence level for all questions given), and calibration level (the difference

between the accuracy and the confidence levels).

### 3.5 Data Analysis Technique

A normality test is conducted to find out whether in the regression model the dependent variable and the independent variables are normally distributed or not. Data are normally distributed if the significance value is > 0.05; if the significance value is <0.05, then the data cannot be considered to be normally distributed. H0 is accepted if the significance value is > 0.05 and is rejected if the significance value is <0.05. After testing the data using the normality test, the normally distributed data will be tested using the analysis of variance (ANOVA) technique, which aims to determine whether there are differences between the two groups that are not paired or do not come from the same data source. The criteria for performing ANOVA are as follows:

a. If the significance value is < 0.05, the hypothesis is accepted, and it can be considered to show variance.
b. If the significance value is ≥ 0.05, the hypothesis is rejected, and this can be considered to show variance.

If the residual value is not normally distributed, using the Kruskal-Wallis H test helps to determine the differences in the media of the two free groups if the scale of the dependent variable is ordinal or interval/ratio but is not normally distributed.

Table 2 *Hypotheses Test Cell*

| Test Complexity | Visualization | |
|---|---|---|
| | High | Low |
| High | Cell 1 | Cell 2 |
| Low | Cell 3 | Cell 4 |

Hypothesis 1 is supported if there are significant differences in the levels of accuracy, confidence, and calibration between the participants who complete tasks with high complexity and those who complete tasks with low complexity: namely Cell 1 < Cell 3, Cell 1 > Cell 4, Cell 2 < Cell 3, and Cell 2 < Cell 4. Hypothesis 2 is supported if there is a significant difference in the calibration level between the participants who receive information with high visualization and those who receive information with low visualization: namely Cell 1 > Cell 2 and Cell 3 > Cell 4. The participants who receive tasks with high or low complexity and with high information visualization have high levels of accuracy, confidence, and calibration compared to those who receive tasks with high or low complexity and with low information visualization. In addition, the participants who receive information with high visualization are expected to have a high calibration level compared to those who receive information with low visualization. The results of the test will be compared using the ANOVA test if the data are normally distributed. The data will be tested using the Kruskal-Wallis test if they are not normally distributed.

## 4. RESULTS AND DISCUSSION

### 4.1 RESULTS

The participants of this study are undergraduate accounting students with knowledge in the fields of financial statement analysis and investment, as well as capital markets management. Table 3 presents the distribution of participants across four scenarios.

Table 3 *The Number of Participants Based on The Experiment Scenarios*

| Scenario | Complexity | Visualization | Number of Participants | Notes |
|---|---|---|---|---|
| I | High | High | 43 | Within subject |
| II | Low | Low | 43 | Within subject |
| III | High | Low | 43 | Within subject |
| IV | Low | High | 43 | Within subject |
| Total Participants | | | 172 students | |

As many as 43 people are in scenario I with tasks in high complexity and high visualization of information presentation; 43 people are in scenario II with tasks in low complexity and low visualization of information presentation; 43 people are in scenario III with tasks in high complexity and low visualization of information presentation; 43 people are in scenario IV with tasks in low complexity and high visualization of information presentation.

Table 4 presents the test results for the relationship between task complexity and investment decision-making for all participants, as measured by the accuracy level (Hypothesis 1a). The results show that the average accuracy level is greater for the participants who complete tasks with low complexity than those who receive tasks with high complexity. Using the 5% significance level, the test also reveals that there are significant differences in the average accuracy level between the participants who complete tasks with lower complexity and those who receive tasks with high complexity. Thus, Hypothesis 1a is supported.

Table 4 *Results of the Kruskal-Wallis Test for Hypothesis 1a*

| Hypothesis | Cell | Task Complexity | Average | Chi-Square | Sig. |
|---|---|---|---|---|---|
| 1a | Cells 1 and 3 | High | 75.42 | 28.637 | 0.000 |
| | | Low | 95.35 | | |
| | Cells 1 and 4 | High | 75.42 | 28.373 | 0.000 |
| | | Low | 94.93 | | |
| | Cells 2 and 3 | High | 68.44 | 41.734 | 0.000 |
| | | Low | 95.35 | | |
| | Cells 2 and 4 | High | 68.44 | 43.735 | 0.000 |
| | | Low | 94.93 | | |

Table 5 presents the test results for the relationship between task complexity and investment decision-making for all participants, as measured by the confidence level (Hypothesis 1b). The results show that the average confidence level is greater for the participants who complete tasks with low complexity than those who receive tasks with high complexity. Using the 5% significance level, the test also reveals that there are significant differences in the average confidence level between the participants who complete tasks with lower complexity and those who receive tasks with high complexity. Thus, Hypothesis 1b is supported.

Table 5 *Results of the Kruskal-Wallis H Test for Hypothesis 1b*

| Hypothesis | Cell | Task Complexity | Average | Chi-Square | Sig. |
|---|---|---|---|---|---|
| 1b | Cells 1 and 3 | High | 86.01 | 18.292 | 0.000 |
| | | Low | 94.19 | | |
| | Cells 2 and 3 | High | 87.42 | 15.605 | 0.000 |
| | | Low | 94.19 | | |
| | Cells 2 and 4 | High | 87.42 | 8.330 | 0.004 |

| | | | | | |
|---|---|---|---|---|---|
| | | Low | 92.03 | | |

Table 6 presents the ANOVA results for the relationship between task complexity and investment decision-making for all participants, as measured by the confidence level (Hypothesis 1b) for Cells 1 and 4. The result shows that the average confidence level is greater for the participants who complete tasks with low complexity than those who receive tasks with high complexity. Using the 5% significance level, the test also reveals that there is a significant difference in the average confidence level between the participants who complete tasks with lower complexity and those who receive tasks with high complexity. Thus, Hypothesis 1b is supported.

Table 6 *ANOVA Results for Hypothesis 1b*

| Hypothesis | Cell | Task Complexity | Average | F-score | Sig. |
|---|---|---|---|---|---|
| 1b | Cells 1 and 4 | High | 86.01 | 7.604 | 0.007 |
| | | Low | 92.03 | | |

The explanation and description of the hypothesis testing result is as follows.

Cells 1 and cell 4: The average data for the two groups show that the average confidence level is higher in decision makers who receive tasks with low complexity (92.03) than in decision makers who receive tasks with high complexity (86.01). The difference in averages for the two groups is statistically significant with a p-value of 0.007, which is less than the probability set at 0.05. It can be concluded that H1b is accepted, which means that there is a significant difference in the confidence level in investment decision making, even though the average confidence level is higher in decision makers who receive tasks with low complexity and with low visualization compared to decision makers who receive tasks with high complexity and with high visualization.

Table 7 presents the test results for the relationship between task complexity and investment decision-making for all participants, as measured by the calibration level (Hypothesis 1b). The results show that the average calibration level is greater for the participants who complete tasks with low complexity than those who receive tasks with high complexity. Using the 5% significance level, the test also reveals that there are significant differences in the average calibration level between the participants who complete tasks with lower complexity and those who receive tasks with high complexity. Thus, Hypothesis 1b is supported.

Table 7 *Results of the Kruskal-Wallis Test for Hypothesis 1c*

| **Hypothesis** | **Cell** | **Task Complexity** | **Average** | **Chi-Square** | **Sig.** |
|---|---|---|---|---|---|
| 1c | Cells 1 and 3 | High | -10.60 | 5.820 | 0.016 |
| | | Low | 1.16 | | |
| | Cells 2 and 3 | High | -18.98 | 18.316 | 0.000 |
| | | Low | 1.16 | | |
| | Cells 2 and 4 | High | -18.98 | 20.047 | 0.000 |
| | | Low | 2.90 | | |

The explanation and description of each hypothesis testing result is given below.

a. **Cells 1 and 3**: the average data for the two groups show that the average calibration level is higher for decision makers who receive tasks with low complexity (1.16) than for decision makers who receive tasks with high complexity (-10.60). Different test results show a significance level of 0.016, so that it is less than the probability set at 0.05. It can be concluded that H1c is accepted, which means there

is a significant difference in the calibration level of decision makers who receive tasks with low complexity, which is higher than that of decision makers who receive tasks with high complexity.

b. **Cells 2 and 3**: the average data for the two groups show that the average calibration of calibration is higher for decision makers who receive tasks with low complexity (1.16) than decision makers who receive tasks with high complexity (-18.98). Different test results show a significance level of 0.000, so that it is less than the probability set at 0.05. It can be concluded that H1c is accepted, which means there is a significant difference in the calibration level of decision makers who receive tasks with low complexity, which is higher than that of decision makers who receive tasks with high complexity.
c. **Cells 2 and 4**: the average data for the two groups shows that the average calibration level is higher for decision makers who receive tasks with low complexity (2.90), than for decision makers who receive tasks with high complexity (-18.98). Different test results show a significance level of 0.000, so that it is less than the probability set at 0.05. It can be concluded that H1c is accepted, which means there is a significant difference in the calibration level of decision makers who receive tasks with low complexity, which is higher than that of decision makers who receive tasks with high complexity.

Table 8 presents the ANOVA results for the relationship between task complexity and investment decision-making for all participants, as measured by the calibration level (Hypothesis 1c) for Cells 1 and 4. The result shows that the average calibration level is greater for the participants who complete tasks with low complexity than those who receive tasks with high complexity. Using the 5% significance level, the test also reveals that there is a significant difference in the average calibration level between the participants who complete tasks with lower complexity and those who receive tasks with high complexity. Thus, Hypothesis 1c is supported.

Table 8 *ANOVA Results for Hypothesis 1c*

| Hypothesis | Cell | Task Complexity | Average | F-score | Sig. |
|---|---|---|---|---|---|
| 1c | Cells 1 and 4 | High<br>Low | -10.60<br>2.90 | 10.314 | 0.002 |

The explanation and description of the hypothesis testing result is given below.

Cells 1 and 4: The average data for the two groups shows that the average calibration level is higher for decision makers who receive tasks with low complexity (2.90) than decision makers who receive tasks with high complexity (-10.60). Different test results show a significance level of 0.002 so that it is less than the probability set at 0.05. It can be concluded that H1c is accepted which means that there is a significant difference in the calibration level of investment decision making, even though the average calibration level is higher in decision makers who receive tasks with low complexity and with low visualization compared to decision makers who receive tasks with high complexity and with high visualization.

Table 9 presents the test results for the relationship between information visualization and investment decision-making for all participants, as measured by the calibration level (Hypothesis 2). The results show that when participants complete tasks with high complexity, the average calibration level is higher for those who receive information with high visualization than those who receive information with low visualization. Using the 5% significance level, the test also reveals that when participants complete tasks with high complexity, there is no significant difference in calibration level between those who receive information with high visualization and those

who receive information with low visualization. Thus, Hypothesis 2 is rejected.

Table 9 *ANOVA Results for Hypothesis 2 (High Complexity)*

| Hypothesis | Cell | Visualization | Average | F-score | Sig. |
|---|---|---|---|---|---|
| 2 | Cells 1 and 2 | High<br>Low | -10.60<br>-18.98 | 2.643 | 0.108 |

The following is the explanation and description of the hypothesis testing result cell 1 and 2: the average data for the two groups shows that when decision makers complete tasks with high complexity, the average calibration level is higher for decision makers who receive information with high visualization (-10.60) than decision makers who receive information with low visualization (-18.98). Different test results show a significance level of 0.108, which is more than the probability set at 0.05. It can be concluded that H2 is rejected, which means there is no significant difference in the calibration level of decision makers who complete tasks with high complexity by receiving information with high visualization compared to decision makers who complete tasks with high complexity by receiving information with low visualization.

Table 10 presents the test results for the relationship between information visualization and investment decision-making for all participants, as measured by the calibration level (Hypothesis 2). The results show that when participants complete tasks with low complexity, the average calibration level is higher for those who receive information with low visualization than those who receive information with high visualization. Using the 5% significance level, the test also reveals that when participants complete tasks with lower complexity, there is no significant difference in calibration level between those who receive information with high visualization and those who receive information with low visualization. Thus, Hypothesis 2 is rejected.

Table 10 *Results of the Kruskal-Wallis H Test for Hypothesis 2*

| Hypothesis | Cell | Visualization on Low Complexity | Average | Chi-Square | Sig. |
|---|---|---|---|---|---|
| 2 | Cells 3 and 4 | High<br>Low | 1,16<br>2,90 | 0,029 | 0,864 |

The following is the explanation and description of the hypothesis testing result. Cells 3 and 4: the average data for the two groups show that when decision makers complete tasks with low complexity, there is a higher average calibration level for decision makers who receive information with low visualization (2.90) than decision makers who receive information with high visualization (1.16). Different test results show a significance level of 0.864, so it is more than the probability set at 0.05. It can be concluded that H2 is rejected, which means there is no significant difference in the calibration level of decision makers who complete tasks with high complexity by receiving information with high visualization compared to decision makers who complete tasks with high complexity by receiving information with low visualization.

**4.2 DISCUSSION**

Hypothesis 1a in this study examines whether decision makers who complete tasks with high or low complexity and with high information visualization have a high level of decision-making accuracy compared to decision makers who complete tasks with high or low complexity and with low information visualization. Hypothesis 1b in this study examines whether decision makers who

complete tasks with high or low complexity and with high information visualization have a high level of decision-making confidence compared to decision makers who complete tasks with high or low complexity and with low information visualization.

Hypothesis 1C in this study examines whether decision makers who complete tasks with high or low complexity and with high information visualization have a high level of decision-making calibration compared to decision makers who complete tasks with high or low complexity and with low information visualization. Hypothesis 2 in this study examines whether decision makers who receive information with high visualization have a high calibration rate compared to decision makers who have information with low visualization.

Table 11 reports the test results for Hypothesis 1. In Hypothesis 1a, the test results for Cells 1 and 3 show that the average accuracy level is higher for participants who complete tasks with low complexity and with high visualization information (95.35) than for participants who receive tasks with high complexity and with high information visualization (75.42). This shows that the higher the complexity level, the lower the accuracy level of participants in making decisions.

Cells 1 and 4 show the average accuracy level is higher for participants who complete tasks with low complexity and with low information visualization (94.93) than participants who complete tasks with high complexity and high information visualization (75.42). This shows that the higher the complexity level, the lower the accuracy level of participants in making decisions. However, information visualization cannot help decision makers make the decision they should. A high level of information visualization is expected to help and improve the accuracy level in decision-making.

Cells 2 and 3 show that the average accuracy level is higher for participants who complete tasks with low complexity and with high information visualization (95.35) than for participants who receive tasks with high complexity and with low information visualization (68.44). This shows that the higher the complexity level, the lower the accuracy level of decision makers in making decisions. However, information visualization can help decision makers make decisions.

Table 11 *Result of Hypothesis Testing*

| Presentation Pattern | Hypothesis | Variable | Cell | Average | Test Result |
|---|---|---|---|---|---|
| Task complexity | 1a | Accuracy | Cells 1 and 3 | 75.42<br>95.35 | There are differences |
| | | | Cells 1 and 4 | 75.42<br>94.93 | |
| | | | Cells 2 and 3 | 68.44<br>95.35 | |
| | | | Cells 2 and 4 | 68.44<br>94.93 | |
| | 1b | Confidence | Cells 1 and 3 | 85.01<br>94.19 | There are differences |
| | | | Cells 1 and 4 | 85.01<br>92.03 | |
| | | | Cells 2 and 3 | 87.42<br>94.19 | |
| | | | Cells 2 and 4 | 87.42<br>92.02 | |
| | 1c | Calibration | Cells 1 and 3 | -10.60<br>1.16 | There are differences |

| | |
|---|---|
| Cells 1 and 4 | -10.60<br>2.90 |
| Cells 2 and 3 | -18.98<br>1.16 |
| Cells 2 and 4 | -18.98<br>2.90 |

Cells 2 and 4 show that the average accuracy level is higher for participants who complete tasks with low complexity and with low information visualization (94.93) than for participants who received tasks with high complexity and with low information visualization (68.44). This shows that the higher the complexity level, the lower the accuracy level of decision makers in making decisions.

Hypothesis 1a test results show that the average accuracy level is higher for participants who complete tasks with low complexity than for participants who complete tasks with high complexity. Although there are tasks with high complexity and with high information visualization that cannot increase the accuracy level of decision makers, higher complexity levels of tasks can reduce the accuracy level of decision makers.

Hypothesis 1b test results for Cells 1 and 3 show that the average confidence level is higher for participants who complete tasks with low complexity and with high information visualization (94.19) than for participants who receive tasks with high complexity and with high information visualization (85.01). This shows that the higher the complexity level, the lower the confidence level of decision makers in making decisions.

With regard to Cells 1 and 4, the average confidence level is higher for participants who complete tasks with low complexity and with low information visualization (92.03) than participants who complete tasks with high complexity and with high information visualization (85.01). This shows that the higher the complexity level, the lower the confidence level in decision-making. However, the information visualization cannot help decision makers make the decision they should. A high level of information visualization is expected to stimulate and increase confidence level in decision-making.

With regard to Cells 2 and 3, the average confidence level is higher for participants who complete tasks with low complexity and with high information visualization (94.19) than for participants who receive tasks with high complexity and with low information visualization (87.42). This shows that the higher the complexity level, the lower the confidence level in decision-making. However, information visualization can enable better decision-making.

Cells 2 and 4 show the average confidence level is higher for participants who complete tasks with low complexity and with low information visualization (92.02) than participants who receive tasks with high complexity and with low information visualization (87.42). This shows that the higher the complexity level, the lower the confidence level of decision makers in making decisions.

The results for Hypothesis 1b show that the average confidence level is higher for participants who complete tasks with low complexity than for participants who complete tasks with high complexity. The tasks with high complexity and with high information visualization cannot increase the confidence level of decision makers; the higher the complexity level of the tasks, the lower the confidence level of the decision maker.

In testing Hypothesis 1c, the results for Cells 1 and 3 show that the average calibration level is higher for participants who complete tasks with low complexity and with high information visualization (1.16) than for participants who receive tasks with high complexity and with high information visualization (-10.60). This shows that the higher the complexity level, the lower the calibration level of decision makers in making decisions.

Cells 1 and 4 show that the average confidence level is higher for participants who complete tasks with low complexity and with low information visualization (2.90) than for participants who complete tasks with high complexity and high information visualization (-10.60). This shows that the higher the complexity level, the lower the calibration level of decision makers in making decisions. However, information visualization cannot help decision makers make the decisions they should. A high level of information visualization is expected to stimulate and improve the calibration level in decision making.

Cells 2 and 3 show that the average calibration level is higher for participants who complete tasks with low complexity and with high information visualization (1.16) than for participants who receive tasks with high complexity and with low information visualization (-18.98). This shows that the higher the complexity level, the lower the calibration level of decision makers in making decisions. However, information visualization can help decision makers make decisions.

Cells 2 and 4 show that the average calibration level is higher for participants who complete tasks with low complexity and with low information visualization (2.90) than for participants who receive tasks with high complexity and with low information visualization (-18.98). This shows that the higher the complexity level, the lower the calibration level of decision makers in making decisions.

The test results for Hypothesis 1c show that the average calibration level is higher for participants who complete tasks with low complexity than for participants who complete tasks with high complexity. Tasks with high complexity and with high information visualization cannot improve the calibration level of decision makers; however, the higher the complexity level of the tasks, the lower the calibration level of the decision maker.

The complexity of the task is a factor that can affect the levels of accuracy, confidence, and calibration of decision makers. If the decision makers feel that the given task has a high complexity level, then it will reduce the levels of accuracy, confidence, and calibration of the given answers. The results of this study are supported by Luciana S. Almilia et al., (2019), who show that there are significant differences in the levels of accuracy, confidence, and calibration, which are higher in decision makers who receive tasks with low complexity compared to the decision makers who receive tasks with high complexity. The results of Tang et al. (2014) also show that there are significant differences in the level of accuracy and confidence, but there is no significant difference in the calibration level.

Table 12 *Results for Hypothesis 2*

| Presentation Pattern | Hypothesis | Variable | Cell | Average | Test Result |
|---|---|---|---|---|---|
| Visualization | 2 | High Complexity | Cells 1 and 2 | -10.60<br>-18.98 | There are no differences |
| | | Low Complexity | Cells 3 and 4 | 1.16<br>2.90 | There are no differences |

Table 12 reports the results for Hypothesis 2. The test results for Cells 1 and 2 show that the average calibration level is higher for participants who complete tasks with high complexity and high information visualization (-10.60) than for participants who receive tasks with high complexity and low information visualization (-18.98). This shows that the higher the information visualization provided, the higher the calibration level of the decision maker; hence, information visualization can help in making decisions.

The test results for Cells 3 and 4 show that the average calibration level is higher for participants who complete tasks with low complexity and with low information

visualization (2.90) than participants who receive tasks with low complexity and with high information visualization (1.16). This shows that information visualization does not help in completing tasks with low complexity. This is because participants who complete tasks with low complexity and with high information visualization have lower average calibration levels compared to participants who complete tasks with low complexity and with low visualizations.

The test of the calibration level in visualization shows that information visualization does not help nonprofessional investors in making decisions. This is contrary to the theory of descriptive support system design and dual coding theory, which states that visualization can support a decision so that a person's confidence level in making decisions can achieve perfect calibration and high information visualization can help someone in making investment decisions.The participants in this research act as nonprofessional investors who do not have experience in investment but have knowledge in the field of financial statement and capital market analysis. This research shows that nonprofessional investors are a type of risk-averse investor. Risk aversion is the behavior of investors who are afraid of risks and tend to avoid risks that result in participants choosing to invest in savings and deposits.

The results of this study differ from those of studies conducted by Tang et al. (2014) and Almilia et al. (2019), which show that information visualization can help in decision-making and increase the calibration level when participants complete tasks with high complexity. The results of this study indicate that information visualization cannot help decision makers improve calibration when making decisions. The results of research conducted by Dilla et al. (2013) state that in investment decision-making, nonprofessional investors are influenced by information visualization, while professional investors are not influenced by information visualization in investment decision making. The results of this study are also different from the research conducted by Dilla et al., (2013). This study uses nonprofessional investor participants and shows that nonprofessional investors are not influenced by information visualization in investment decision-making.

## 5. CONCLUSIONS

This study aims to determine whether there are differences in the levels of accuracy, confidence, and calibration in investment decision-making between participants who receive tasks with high or low complexity and with high information visualization and those who receive tasks with high or low complexity and with low information visualization. It also seeks to examine the calibration level between participants who receive tasks with high complexity and with high or low information visualization, and those who receive tasks with low complexity and with high or low information visualization.

This study employs a quantitative approach through the use of primary data and relevant instruments for data collection. The sample comprised students from the undergraduate accounting department at STIE Perbanas Surabaya; while they had no experience in investment, they possessed knowledge related to financial statement analysis and investment and capital market management. The conclusions drawn from the hypotheses testing results are as follows:

1. There is a significant difference in the accuracy levels between participants who complete tasks with high or low complexity and with high information visualization and those who complete tasks with high or low complexity and with low information visualization.
2. There is a significant difference in the confidence levels between participants who complete tasks with high or low complexity and with high information visualization, and participants who complete tasks with high or low complexity and with low information visualization.
3. There is a significant difference in the calibration level between participants

who complete tasks with high or low complexity and with high information visualization and those who complete tasks with high or low complexity and with low information visualization.

4. There is no difference in the calibration levels between participants who complete tasks with high complexity and with high or low information visualization and those who complete tasks with low complexity by receiving information with high or low visualization.

The results of this study also demonstrate the behavior of nonprofessional investors in making decisions not assisted by the visualization of information. Although nonprofessional investors obtain information with high visualization, tasks with high complexity can reduce the level of accuracy, trust, and calibration in their decision-making. This is because a nonprofessional investor is more focused on the difficulty of the assignments that must be resolved, and thus, even a high level of information visualization does not help in investment decision-making. This implies that the individual attributes of nonprofessional investors affect the results of this study.

Some of the limitations of this study are as follows: (1) The minimum criterion for qualifying general accounting knowledge should be when the participant is able to answer as many as three out of five questions. However, at the time of the test, a large number of participants answered two out of five questions correctly. Therefore, the data that can be tested decreased; (2) During the experiment, there were students who were noisy, resulting in an atmosphere that was less conducive; (3) some participants made a sudden cancellation before the D-day, and hence, the researchers had to immediately find a replacement for these participants who met the predetermined criteria. In addition, some participants canceled their participation on the D-day, and the researchers had to evenly divide the distribution of participants in each class so that the number of participants was balanced.

Based on the results, conclusions, and limitations presented in this paper, future researchers should ensure a more conducive and calm atmosphere during the experiment by paying more attention to participants; is the conditions should not disturb the participants' concentration. The questions on general accounting knowledge should be made easy and understandable for participants, so that more data can be assessed and are not excluded. Researchers should also arrange for additional participants in advance in accordance with the research criteria to anticipate sudden cancellations.

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