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Graphical and Textual Presentations in Financial Reports

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Abstract

The use of separate graphs and texts to disclose information is a frequent occurrence in corporate annual reports. Multiple sources of information does not enhance understanding of users of financial statements. This chapter compares spatially separated text and graphs with integrated presentations that aim at bringing text and graphs as close as possible to each other. The chapter begins by illustrating the concept of split attention. Cognitive load arises when disparate sources of accounting information need to be mentally integrated by users. An experiment using separate text and diagrams is then presented to demonstrate how participants can deal with cognitive overload when reading split-attention material. Using two instructional design formats, the split-attention format and the integrated format, first-year accounting students were used as surrogates for financial report user groups such as employees and shareholders. The presence of the split-attention effect in the financial accounting material was established. Effective use of text and diagrams in integrated reporting helps integrated thinking and assists the interconnectedness of information. The findings suggest that redesigning financial reports by integrating text and diagrams may make effective use of the available cognitive resources and possibly enhance investors and other stakeholders' decision-making process.

Keywords: accounting, cognitive load theory, financial reports, graph, split-attention

1. Introduction

Companies are increasingly using graphs, text and other visual representation methods to communicate financial information to their stakeholders. But do these forms of presentation enhance users understanding of the annual reports? In most cases, these companies augment the graphs with related notes below, above or on the side of the graph. While there is now a

sizeable body of research on different aspects of presentations, such as the use of graphs in annual reports, graphs versus tables and numerous other narratives [1, 2], graphs and text proximity in corporate reports have received very little attention. Yet, graphs and texts are increasingly being used in annual financial reports. The purpose of the present chapter is to review the split-attention effect and present an experiment on graphs and text proximity, in order to identify a presentation format that enhances user understanding of corporate annual financial statements.

It is frequently suggested that graphs can aid the communication of accounting information [3]. Moreno et al. [4] study involving electrical engineering students as subjects revealed some interesting observations regarding concrete and abstract representations. Participants received instructions using abstract representations (e.g. electrical symbol for light bulbs), concrete representations (e.g. light bulbs) and both concrete and abstract representations. Moreno et al. [4] stated that in the past research studies, concrete representations had been shown to distract from learning compared to abstract representations. However, Moren, Ozogul and Reisslein's new study showed that the greatest learning occurred when a combination of concrete and abstract representations was used. Moren et al.'s study [4] revealed that visual representations play a critical role in learning and that visual representation is a vital tool of experts in problem solving and reasoning.

It is also suggested, however, that graphs can be misleading [5]. For example, graphs have been found to intentionally introduce distortions into the communication process, which misleads users of financial reports. Distortion of information is introduced by selectivity of some form and non-compliance with the principles of graph construction. This may involve a decision on whether or not to use graphs, and if they are used, a further selectivity could be in the particular choice of financial variables graphed [5]. Another distortion of graphs in annual reports is to reflect only one or two indicators, particularly favourable to the company instead of a number of indicators [6]. There are many ways a graph can be altered and would have the potential to affect users' perceptions mainly for the purpose of serving managerial interests rather than user interests [7]. Distortion of graphs results in the message conveyed as no longer being unbiased and neutral.

The effect of graph and text proximity in the context of financial reporting is largely unexplored. What is known is that graphs can aid the communication of accounting [8] and that preparers of accounting reports may intentionally create graphs that are misleading. The purpose of the present chapter is to conduct an experiment that compares spatially separated text and graphs with integrated presentations that aim at bringing text and graphs as close as possible to each other within the context of corporate annual reports. The three main research objectives are (1) to establish the existence of split-attention effect on graph and text presentations, (2) to investigate whether the integrated format group will outperform students in the split-attention format group on recall and transfer test items and (3) to investigate whether students in the integrated format group will report higher effort (cognitive load) than students in the split-attention format. Superiority of the integrated format will favour bringing text as close as possible to the related parts of the diagram in corporate financial reports.

The remainder of this chapter contains four sections. In the first section, we review the split-attention effect. Section 2 provides the study context. An outline of the experiment is given in the third section. Our results are presented in the final section, together with a discussion of the implications of our results.

2. Split-attention effect

Split-attention effect asserts that when designing instructional materials, it is important to avoid formats that require learners to split their attention between multiple sources of information. Existence of split attention would require the learner to mentally integrate the different sources of information, which has a negative effect on learning [9]. Since 1988, research into split attention investigated the effectiveness of worked examples as they had proven to be highly effective for learning algebra [10]. However, neither worked examples nor highly directed but not a full worked example (guided solutions) enhanced students' performance when compared with the conventional problem-solving strategies [11]. This led to the conclusion that the format of the worked examples, a diagram and separate text in the form of solution steps (such as that shown in **Table 1**), must increase cognitive load.

Over the years, presenting text and diagrams together rather than apart in instructional material has repeatedly been shown to enhance learning when compared to studying separate

Balance sheet		
Description	Amount	
Cash at bank	XX	Assets are resources controlled by an entity as a result of past events and from which future economic benefits are expected to flow to the entity. These economic benefits can be tangible (having physical characteristics) such as land buildings and equipment or intangible (assets without physical existence) such as legal claims or patent rights.
Accounts receivables	XX	
Building	XX	
Total assets	XXXX	
Liabilities	XX	
Accounts payable	XX	
Mortgage payable	XX	
Total liabilities	XXXX	
Net assets	XX	
EQUITY	XX	
XY, Capital	XX	
Total equity	XXXX	

Table 1. Format of the balance sheet normally found in textbooks.

text and diagrams [11]. **Table 1** illustrates split attention in financial accounting. The diagram is above the text which outlines the solution to the problem and in processing the information, the learner has to understand the solution steps presented as text and then match the steps with the diagrammatic representation [12]. This process requires mentally combining the two sources of information and a considerable amount of cognitive resources, not necessarily directly related to learning. Very little resources are then available for learning. In the case of undergraduate accounting learners, this is particularly important as most of them are meeting the instructional material for the first time and lack the proper schemas to integrate new information with their previous knowledge [13]. In the integrated worked example (see **Table 2**), the student focuses on the relational dimensions of the problem because the learners’ mental capacity is released from the need to search and match the solution steps and link with the diagram [9].

Several studies have found that the searching and matching required by split-attention instructional material is inefficient and has a negative effect on learning [11, 14]. During their studies, students are likely to encounter various texts separated from diagrams in textbooks and other accounting instructional material. Integrating spatially separated information into successful problem solutions can be difficult [10].

Split-attention effect is guided by cognitive load theory (CLT). The use of CLT, as part of accounting instructional design, is compelling due to the robust way in which its general principles apply to a wide variety of instructional settings. There are various reports where

Balance sheet		
Description	Amount	
Cash at bank	XX	Assets are resources controlled by an entity as a result of past events and from which future economic benefits are expected to flow to the entity. These economic benefits can be tangible (having physical characteristics) such as land buildings and equipment or intangible (assets without physical existence) such as legal claims or patent rights.
Accounts receivables	XX	
Building	XX	
Total assets	XXX	
Liabilities	XX	
Accounts payable	XX	
Mortgage payable	XX	
Total liabilities	XXX	
Net assets	XX	
EQUITY	XX	
XY, Capital	XX	
Total equity	XXX	

Table 2. Integrated format of the balance sheet.

CLT-derived principles have improved learning outcomes [9, 15, 16]. Even though there is extensive empirical application of CLT principles in other disciplines, its use in accounting has been very limited.

3. Importance of split-attention effect to financial reports

Financial reports often consist of a statement of financial position, statement of comprehensive income, statement of cash flows, statement of changes in equity and notes to financial statements. Knowing basic principles in accounting provides the basis for understanding and interpreting accounting information, which is required in later years [10]. The basic principles comprise essential foundation for future applications by practitioners or for further study in the field of accounting. One of the main focuses of the financial statements is to illustrate how accounting information may be used in the decision-making process [16].

Financial reports usually have numerous diagrams and text [17]. A statement of financial position shows the state of a business on a particular date and is the result of a complex and long recording process that involves a record of transactions, posting to the respective ledger accounts and the preparation of a trial balance [18]. The users of the statement of financial position tend to regard it as proof of both the difficult nature of accounting and the technical competence and reliability of the accountants and auditors involved [9]. One of the reasons for the complication is the way the statement of financial position is presented. In most cases, the statement of financial position consists of a diagrammatic presentation followed by an explanation of each of the components, thus evoking the split-attention effect. A similar type of presentation is used for other financial statements, such as the statement of comprehensive income and the cash flow statement. As has been stated in the preceding sections, such separate text and diagrams require split attention, which does not enhance learning [4].

3.1. Integrated thinking, integrated reporting and integrated presentations

Integrated thinking is referred to as the “active consideration by an organization of the relationships between its various operating and functional units and the capitals that the organisation uses or affects. Integrated thinking leads to integrated decision-making and actions that consider the creation of value over the short, medium and long term” [19]. Integrated thinking is a key feature driving integrated reporting.

Proponents of integrated reporting suggest that traditional financial reporting has not kept pace with the changes in macro-economic value experienced over the years and that IR provides a richer picture [20]. Others argue that IR provides a concise, clear representation of how an organisation creates value and reveals sustainability [21]. The IR report provides information on financial and non-financial performance in a single document, showing the relationship between financial and non-financial performance and how these inter-related dimensions are creating or destroying value for shareholders and other stakeholders. Integrated reporting brings together information about an organisation’s governance, performance, strategy and

prospects in a way that it reflects the social, commercial and environmental context within which it operates [20]. Such IR supports better integrated thinking, which has the potential to be complimented by integrated text and diagrammatic presentations. Integrated thinking has a broader appeal than the traditional business decision-making, which tends to focus on short-term financial outcomes. The IR framework elicits multiple representations of information about organisational governance, strategy, performance and prospects in order to accomplish integrated thinking. Consistent with integrated thinking, the use of integrated text and diagrams makes such presentations more concise, clear and comparable.

Promoting user understanding of financial reports can only be brought about by well-designed text and diagrams. Providers of financial statements have attempted to expose users to a variety of presentations and in various ways, including online, to the extent of financial information overload. Information overload has widely been recognised to have adverse effects on decision quality [16]. To help overcome the information overload, users have to be exposed to alternative presentations, which have the potential to aid better understanding and decision-making. As illustrated, many financial statements require users to unnecessarily split their attention between diagrams and text. An alternative presentation, called the integrated format, is to have related diagrams and text as physically close as possible to avoid the extensive search-and-match behaviour. Various research studies have shown that text and diagrams need to be integrated in order to overcome the negative effects on understanding caused by split-attention design [22]. Consequently, this chapter presents an investigation on whether users (represented by students) can benefit more from integrated financial statements.

4. Study context

This study was conducted with accounting students at an Australian university. Undergraduate first-year students were used as suitable surrogates for employees, shareholders and other stakeholders as prior knowledge of accounting is not usually a prerequisite for users of financial reports. Prior research has demonstrated that studies requiring no prior knowledge can be completed by the surrogates [23]. According to Trotman [23], students may be suitable surrogates where the research does not rely solely on prior learning and the task can be completed by the surrogates. Liyanarachchi [24] supports their use in decision-making studies and suggests that maintaining the realism of experiments and replication of prior results is more critical with respect to generalisability than the use of real subjects. In the experiment reported in the current study, students were used as surrogates for the users of financial reports. Participants are assigned to two different formats in order to examine the effect of these formats on their understanding of financial reports. The first instructional format is split attention which is normally found in financial reports. The second is the integrated format, which involves bringing text and diagrams as close as possible to each other. The redesigning of financial reports to comply with integrated format was created in order for comparisons to be made.

The experiment sought to test the hypothesis that students in the integrated format would perform better than students in the split-attention format. Participants were randomly assigned

to one of the two conditions. In the split-attention format, instructional materials were formatted in the same way as in the published financial statements. In the integrated format, the content was formatted in a different way to decrease split attention by bringing the diagram and text as close as possible to each other. Random assignments ensured that each student had an equal opportunity of being chosen to participate in the study [25]. A computerised random creation of participant numbers and allocation to groups based on the numbers generated were undertaken. The first 41 students were allocated to the split-attention group and the next 40 students were allocated to the integrated group.

Subjective rating scales were used to assess cognitive load and are the preferred method in most recent research. The rating of perceived task difficulty, which asks learners to rate the perceived difficulty of a task on a 9-point Likert scale, ranging from “very, very easy” to “very, very difficult,” was used [26]. It was chosen as it is widely used in various cognitive load research studies since the early development of CLT [27]. Students rated task difficulties, for example, “How much mental effort did you invest to answer this question?” at the end of each test question. The rating scale consists of a line marked with nine anchor points, each accompanied by a descriptive label indicating a degree of effort. After every task in the test phase, students had to rate how much mental effort they invested.

How much mental effort did you invest to answer this question? (Please circle)

1-----2-----3-----4-----5-----6-----7-----8-----9

The tasks selected were diagrams and texts about ratios and the accounting equation. These tasks were selected because they have separate text and diagrams and were likely to exhibit clear associations with financial statements normally presented to users of financial statements.

5. Experiment

A pre-test questionnaire was first used to collect information about each student’s age, gender, knowledge of accounting and language. In total, 45% female and 55% male students were randomly assigned to one of the two conditions. Thirty-six students in the first group were the split-attention group (Group 1: 13 females and 23 males, and $M = 21$ years old and standard deviation (SD) = 3.85) and 40 students were in the integrated group (Group 2: 14 females and 21 males, and $M = 20$ years old and $SD = 1.84$). The students were not paid and participated voluntarily in the study. With regard to performance, students in the integrated format group (Group 2) would be expected to outperform students in the split-attention format group (Group 1). This is due to the integrated materials requiring less mental effort than those in the split-attention group. This expectation follows from the fact that split attention requires that more working memory resources be utilised.

Students used pen and paper-based materials. In total, they were three pages of recall and transfer test questions to be answered which included a requirement to rate mental effort after answering every test question. Initially, participants reported their understanding of ratios

and the accounting equation on a 5-grade category ranging from very poor to expert level. A one-way analysis of variance (ANOVA) was conducted on pre-test responses of age and basic knowledge of accounting to explore differences across the two groups involved in the experiment. Means and standard deviations are shown in **Table 3**. The one-way ANOVAs for pre-test questions demonstrate no significant main effect of group for age ($F(1, 70) = 0.851, p = 0.562$) and knowledge of accounting ($F(1, 70) = 0.655, p = 0.421$), thus enhancing the likelihood that any significant differences identified later are more likely due to the different treatment conditions.

5.1. Procedure

The demographic information was collected by using a pre-coded number on the learning materials and question papers for the split-attention group and the integrated group in order to guarantee anonymous data collection. Students were told that their information would be treated as confidential. Participants were then given the information sheets and consent forms, and they all indicated their agreement by signing the form.

A pilot study aimed at refining instructional guidance was conducted before the experiment. The pilot study informed the time that was to be allowed for each phase of the studies. Two students took part and they did not participate in the main experiment. Based on the pilot study, a time of 45 minutes for completion of the experiment was determined.

Instructional format	Mean rating	Standard deviation
Test phase–recall		
Split attention ($n = 36$)	57.61	12.13
Integrated ($n = 35$)	63.42	11.77
Test phase–transfer		
Split attention ($n = 36$)	31.47	20.54
Integrated ($n = 35$)	52.40	21.99
Learning phase		
Split attention ($n = 36$)	6.42	1.59
Integrated ($n = 35$)	4.74	1.92
Test phase–recall		
Split attention ($n = 36$)	6.55	0.96
Integrated ($n = 35$)	5.22	1.24
Test phase–recall		
Split attention ($n = 36$)	5.39	0.93
Integrated ($n = 35$)	4.37	1.33

Note: Actual raw score ranges were 0–28 for recall and 0–11 for transfer. The actual mental effort ratings were from 0 to 9 for cognitive load.

Table 3. Means and standard deviations for learning and test-phase mental effort ratings.

The experiment involved three phases. During the first phase, students completed their gender, language, knowledge of accounting and their age. The completion of this section took 10 minutes. During the next phase (learning phase), the participants were given 15 minutes to analyse the learning materials given to them. After the second phase, the test which consisted of transfer and recall question items was administered. The students were given 45 minutes to complete the test.

5.2. Results and discussions

5.2.1. Performance measures

A one-way ANOVA was conducted on test performance scores to explore differences between the two groups involved in the first experiment. Means and standard deviations are shown in **Table 3**. A one-way ANOVA for recall scores showed a statistically significant main effect for the recall test items ($F(1, 70) = 4.206$, $p < 0.05$, large effect size $d = 0.48$) [28]. The mean recall scores showed that the integrated group had higher scores than the split-attention group. The one-way ANOVA for transfer questions also demonstrated a significant main effect of group ($F(1, 70) = 17.185$, $p < 0.05$, and effect size $d = 0.98$). The integrated format group performed significantly better than the split-attention group.

5.2.2. Mental effort rating on instruction

The results from the one-way ANOVA for mental effort invested in the learning phase are shown in **Table 3**. They indicate significant differences across the two formats ($F(1, 70) = 16.07$, $p < 0.05$, with a large effect size, $d = 0.95$) [28]. Consistent with predictions, there were large and significant between-group differences of mean mental effort rating on learning results. The integrated group reported lower levels of cognitive load than the split-attention group.

A one-way ANOVA was conducted on the mental effort that the participants provided after each test question. **Table 3** shows the mean ratings and standard deviations for the ratings of the test phase. Again, there were large and significant between-group differences on mean recall results ($F(1, 70) = 25.349$, $p < 0.05$, large effect size, $d = 1.19$). Transfer items also revealed a significant effect between groups ($F(1, 70) = 13.972$, $p < 0.05$, large effect size, $d = 0.88$). The ratings for both the learning phase and the transfer phase showed that the integrated group reported a lower perceived amount of mental effort than the split-attention group.

5.2.3. General discussion

The experiment was designed to test whether participants in the integrated group would perform better than those in the conventional split-attention group. In addition, transfer test items were designed to establish whether the effect could be obtained with new, different and slightly more challenging questions. Students in the integrated group demonstrated higher performance than students in the split-attention group for both recall and transfer tasks.

As expected, in the experiment, students in the integrated group reported lower perceived cognitive load than students in the split-attention format group. Students in the split-attention

group performed badly as compared to the integrated group in both the recall and transfer tasks. This was probably caused by requiring the split-attention group to refer to multiple sources of text and diagrams. This finding possibly illustrates that financial reports that integrate text into the diagrams in a manner which facilitates understanding may be more beneficial than split-attention financial reports. Apparently, the processes required to work during the test phase demanded different amounts of mental effort in all conditions. When the data are differentiated for recall and transfer, the results still revealed the same tendency, with the integrated group reporting the lowest level of cognitive load.

The major finding from this study relates to the participants' preference for integrated accounting material whether they were answering recall or transfer tasks. This is largely similar to financial reports which require users to split their attention between diagrams and text. Financial reports, similar to the text and diagrams used in this study material, do indeed demonstrate such split-source formats, and this has a negative effect on users of these reports. The most interesting outcome to emerge from this experiment is the consistency with which the integrated group outperformed the split-attention group. The participants in the integrated group did in fact maintain their high performance and reported lower cognitive load under both recall and transfer tasks. The superiority of integrated material seems to support Moreno et al.'s study [4] in engineering, which showed that the greatest learning occurred when a combination of concrete and abstract representations was used.

A further explanation of the results is that the superiority of the integrated condition might have resulted from the text which was already as close as possible to the relevant aspects of the diagram, which enhanced the students' learning. This is consistent with studies by Tindall-Ford et al. [29].

5.2.4. Implications of the findings and limitations and suggestions for future research

As discussed previously, the fundamental purpose of redesigning financial reports is to make an effective use of the available cognitive resources and possibly enhance investors and other stakeholders' decision-making process. The study reported in this chapter provides a first trend in this direction by reporting significantly better performance in the integrated format groups than in the split-attention format groups.

As demonstrated, the integrated format requires significantly lower cognitive load on the user of financial reports than the split-attention format. The evidence of the effectiveness of integrated financial materials adds to research into this effect in other domains. By demonstrating the very effective consequences of integration, the experiment suggests that preparers of financial statements should consider shifting focus away from "split-attention" format towards "integrated" format.

Integrated reporting has been heavily promoted during the past decade, as this chapter has demonstrated. It must be recognised that the concept demonstrates the linkages between an organisation's strategy, governance and financial performance and the social, environmental and economic context within which it operates. Such a framework would involve, in most instances, text and graphical presentations which have to be combined in order to

achieve “integrated thinking” [30]. Embedding integrated text and diagrams into the integrated reports would make the reports concise and clearer, facilitating the integrated thinking process.

There are a few important limitations of the chapter presented. Over the years, the measurement of mental effort has been a challenge [27]. The specific type of mental effort was not directly measured; future research might attempt to determine the precise type of mental effort reported by the students. In addition, there are possibly other factors that might have influenced students’ performance and mental effort ratings. These could be emotional stress, levels of motivation and other non-cognitive factors may have confounded with the two cognitive load components. The use of students as surrogates may be another limitation. In this study, it appeared reasonable to use first-year undergraduate students as they may be perfect substitutes for employees and other stakeholders who may not be experts in accounting. Further research may use employees and other stakeholders. Finally, although split attention is found in ratios and T accounts instructional material, future research may use authentic financial reports that are given to employees and shareholders.

The experiment in this chapter has demonstrated to benefit from integrated financial reports and manage the cognitive load of the users of financial statements. Most importantly, the chapter has shown that such integrated presentations may be useful even for transfer tasks. The future research direction may include investigation of cognitive load measurement, in particular the measurement of each type of cognitive load.

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