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The Effects of Presentation Formats on Understanding Financial Accounting: an Experimental Study

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Abstract

Most financial accounting presentations consist of graphs and tables with subtle variations in the way that the associated text is presented. While alternative presentations of tables versus graphs have been widely researched, the impact of text proximity to a graph or table has received little attention. This study experimentally examines the effects of two instructional design formats on student's understanding of financial accounting. Graphical presentation effectiveness was operationalised as accuracy and mental effort in answering questions of different levels of complexity. Using financial accounting instructional material presented either as a graph and separate text or text embedded in the graph, participants responded to recall and transfer questions. The results of an experiment suggest a strong relation between presentation format and understanding of financial accounting. Accounting students understand an integrated graph more than a separate graph and text. We conclude that there is value accruing from close proximity of text to the graph, but suggest additional benefits may be reaped from presenting text and diagrams in an integrated form.

Keywords

Accounting, learning, presentation formats, recall, transfer, graphs, tables.

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Most financial accounting presentations consist of graphs and tables with subtle variations in the way that the associated text is presented. While alternative presentations of tables versus graphs have been widely researched, the impact of text proximity to a graph or table has received little attention. This study experimentally examines the effects of two instructional design formats on student's understanding of financial accounting. Graphical presentation effectiveness was operationalised as accuracy and mental effort in answering questions of different levels of complexity. Using financial accounting instructional material presented either as a graph and separate text or text embedded in the graph, participants responded to recall and transfer questions. The results of an experiment suggest a strong relation between presentation format and understanding of financial accounting. Accounting students understand an integrated graph more than a separate graph and text. We conclude that there is value accruing from close proximity of text to the graph, but suggest additional benefits may be reaped from presenting text and diagrams in an integrated form.

JEL Classification: M40

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Introduction

The use of instructional materials consisting of diagrams or formulas presented separately from the associated text is widely used in accounting. Such diagrammatic presentation with text below, above or on the side often divides attention and presents an unnecessary load. A student may be forced to process information while holding certain items of information in their working memory. For example, to understand the accounting cycle presented in a conventional separate text and diagram format, the learner must hold small segments of text relating to each step in working memory while searching for the matching diagrammatic entity. This process continues until all the information is rendered intelligible (Ginns, 2006; Sweller et al., 2011). The process of mental integration is not directly related to learning. It is an essential preliminary activity to learning (Kalyuga, Chandler & Sweller, 2011). If students spend most of their time searching and matching, then their learning may not be enhanced (Sweller, 2015; Sweller et al., 2011). The integration of text and diagrams has significant cognitive implications for learners since the capacity of a learner to comprehend instructional material is directly related to how much cognitive load is used to understand the material (Sweller, 2015).

Carefully redesigning accounting instructional material can improve students understanding of difficult concepts, principles and procedures in accounting. The first step involves identifying learning material that is presented in a split-attention format such as a separate diagram and text or separate formula and text. Followed by restructuring the material in a manner that brings the text as close as possible to the relevant parts of a diagram or formula. Such a reorganization of diagrams and texts would reduce the need to search the solution steps within the text and match them with corresponding parts of the diagram. This frees up mental resources that would focus on the learning process.

The optimum format (graph or table and the associated text) for presenting the information may depend upon several factors. Two of the important factors are: (1) the extent to which text is embedded in the graph or diagram (2) the proximity of the text to the graph or table. Financial accounting instructional material should provide information that contains the relevant format to support the student learning process (Potter & Johnston, 2006; Sithole, Chandler, Abeysekera & Paas, 2016). Otherwise students learning financial accounting may face difficulties understanding the principles and concepts.

This paper examines the effect of graphical presentations with associated text as close as possible versus separate graph and text. It extends the previous research in several ways. First, the effects of different types of visual presentation (graphs, tables, pictures) to users understanding of accounting information is the key focus of several previous studies (e.g. Hard & Vanecek, 1991; Kelton, Pennington & Tuttle 2010; Strong & Portz, 2003; Tang, Hess, Valacich & Sweeney 2014; Volkov & Laing, 2012). Prior research has examined how different presentation formats (e.g., tables and graphs) impact financial decision-making accuracy (Kelton, Pennington, & Tuttle 2010; Volkov & Laing, 2012). Other studies have investigated the effects of financial statement information proximity and extensiveness of financial accounting (Ghani, Laswad, Tooley & Jusoff, 2009; Hodge et al., 2010). Hodge et al. (2004) and others investigated research questions tangentially related to proximity (Hodge et al., 2004; Hodder, Hopkins & Wood, 2008). Very few studies have investigated the use of graphical presentations in relation to text and graphical proximity in accounting (e.g. Sithole 2015b; Tanlamai & Soongswang, 2011). Using cognitive fit theory Tanlamai and Soongswang (2011) argued that higher level of learning performance will be achieved, if the type of visual representation matches the information processing requirement of the type of task activity. These studies looked at the value of table versus graph, visual effects of graphical presentation and the benefits of financial graphs and other visual presentations in accounting. Text and graphical proximity (integration) was not the primary variable of interest. Second, the presentation format is of critical concern to accounting regulators, standard setters, managers and other users and preparers of accounting information (Kelton, Pennington & Tuttle, 2010; Sithole 2015a). Discussions and decisions made by the Financial Accounting Standard Board and the International Accounting Standard Board (IASB) have generally supported increased proximity and increased integration of performance related information (Hodge, Hopkins & Wood, 2010). The benefits of increasing information proximity and the extent to which it can be done has not been fully explored (Kelton, Pennington & Tuttle, 2010). We address two fundamental questions related to accounting instructional material presentation format. First, within financial statements, does bringing text as close as possible to a table or graph enhance understanding of accounting learners? Second does the separation of text and diagrams increase mental effort and affect understanding of the financial statements?

The remainder of the paper is organised as follows. The next section discusses cognitive load theory (CLT) which suggests that learning happens best under conditions that are aligned with human cognitive architecture. The theory is concerned with techniques for reducing working memory load in order to facilitate the changes in long term memory which would enhance understanding. This is followed by a discussion of the instructional designs that have come out of CLT and in particular split-attention effect which is the main focus of this study. The third section describes the experimental design of the current study. In the third and fourth sections, the results are presented and discussed. The final section presents conclusions, limitations and areas for future research.

Cognitive Load Theory and Hypotheses Development

Cognitive load theory is based on the assumption that human cognitive architecture consists of a working memory with very limited capacity when dealing with new information (Sweller, 2015) and an unlimited long-term memory in which elements are organised and stored in the form of domain-specific knowledge structures known as schemas (Van Merriënboer & Ayres, 2005). Working memory can only hold a limited number of elements at any given time (Sweller, 2015) and has the capacity to access complex schemas consisting of huge arrays of interrelated elements. This allows a learner to benefit from previously learned material stored in the long-term memory. Such storage of information in the form of schemas in long-term memory frees up the cognitive load on working memory. However, students learning new content may not have prior information stored in long-term memory (Kirschner, Sweller & Clark, 2006).

CLT suggests that effective instructional design should take into account human cognitive architecture, in particular concentrating on effective use of limited working memory resources (Ginns, 2006; Liu, Lin, Tsai & Paas, 2012; Sweller, 2015). CLT identifies three types of loads. Extraneous cognitive load is the burden imposed on working memory by the manner in which the information is presented or the activities in which the learner must engage (Sweller, Ayres &

Kalyuga, 2011). This excessive load can result from poorly designed instructional material. Intrinsic cognitive load refers to the complexity of a task relative to an individual learner. It occurs because the demands on working memory capacity imposed by element interactivity are intrinsic to the material being learned (Paas et al., 2003). Low element interactivity instructional materials allow distinct elements to be learned with very little reference to other elements and consequently impose a low working memory load (Sweller, 2010). Intrinsic cognitive load cannot be changed by instructional alterations, although simultaneous processing of all necessary elements must happen because it is only then that understanding commences (Paas et al., 2003). Activities that involve cognitive load and effort directly relating and contributing to schema development and automation are referred to as germane load (Chinnappan & Chandler, 2010).

Modifying the design of presentations to optimize understanding of complex tasks by efficiently using the relation between the limited working memory and unlimited long term memory is one of the essential recommendations of cognitive load theory (Paas & Ayres, 2014; Paas, Van Gog & Sweller, 2010). To achieve this goal, cognitive load theory researchers attempt find designs that substitute productive for unproductive working memory load. For example, when learning new content, formats having a separate diagram and text hinder learning because they require a learner to search matching text with relevant sections of the diagram (Jarodzka, Janssen, Kirschner & Erkens, 2015; Sithole 2015b). Research has shown that searching and matching unnecessarily overloads the limited capacity of working-memory and does not contribute to the learning process (Sithole et al., 2016; Tindall-Ford, Agostinho, Bokosmaty, Paas & Chandler, 2015). Hence many studies have illustrated the importance of designing material with CLT principles in mind. Some of the most researched CLT derived instructional effects include (a) split-attention effect - replacing multiple sources of information with an integrated single source of information (e.g., Ayres & Sweller, 2005; Clark, Ngyuen & Sweller, 2006; Ginns, 2006; Sithole et al., 2016) (b) worked example effect – a step-by-step solution to a problem assist learners develop problem-solving schema (e.g., Owens & Sweller, 2008; Paas & Van Gog, 2006; Sweller, 2006) (c) redundancy effect – reduce the presentation of the same information, which can be understood in isolation, in different modalities (e.g., Diao, Chandler & Sweller, 2007; Samur, 2012) (d) expertise reversal effect - adjust instruction based on levels of learner expertise (e.g., Blayney, Kalyuga & Sweller, 2010; Oksa, Kalyuga & Chandler, 2010) (e) modality effect - engage both auditory and visual channels of information rather than just the visual channel (e.g., Ginns, 2005; Goolkasian, Foos & Eaton, 2009; Harskamp, Mayer & Suhre, 2007). For and exhaustive review of research underpinning these theoretical assumptions see Sweller et al. (2011) and Van Merriënboer nd Sweller (2005).

Cognitive Load Theory and understanding of graphical presentations

Evidence from cognitive load theory suggest that information presented as separate text and diagrams is very difficult to understand and consequently has a negative effect on learning (Florax & Ploetzner, 2010; Morrison, Dorn & Guzdial, 2014; Sithole et al., 2016). Therefore, this form of presentation, referred to as split-attention, demands the learner's effort to mentally reorganize the text or related explanations related to the diagram and/or symbols. An example of split-source materials is presented below (see Figure 1). In most conventional presentations, the distance between the text and the diagram may be larger than that shown in Figure 1 and may be mixed with text unrelated to the diagram. To create effective learning environments the accounting graphs and texts could be integrated into a single source of information embedding the written steps within the diagram as shown in Figure 2. The level of “mental energy” required to process information in Figure 1 is more than for the same diagram with text embedded within it (as shown in Figure 2). The division of cognitive resources under split-source (Figure 1) This can be mitigated by integrating related information (see Figure 2). It is argued that, as learners are no longer required to mentally search and match text with diagram, extraneous load is reduced and cognitive resources are freed for learning (Sithole et al., 2016; Tindall-Ford, Agostinho, Bokosmaty, Paas & Chandler, 2015).

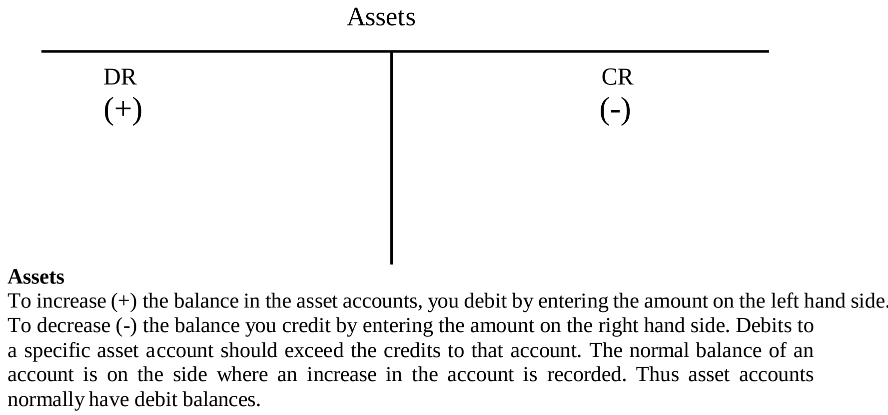

***Figure 1*. Example of conventional split-attention format.**

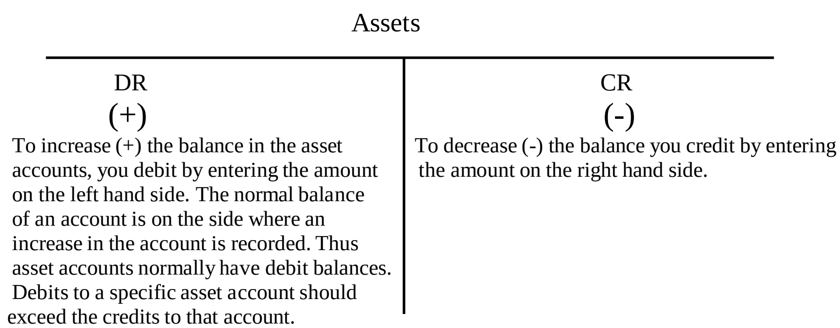

***Figure 2*. Example of the integrated format.**

Empirical findings have provided support for the split-attention effect in learning mathematics (e.g., Tarmizi & Sweller, 1988), physics (e.g., Ward & Sweller, 1990), engineering (e.g., Mayer, 1989) and second language learning (e.g., Chung, 2008). Students tend to demonstrate less time for task and more accurate answers if there is physical integration of the different information sources. If the diagram is combined with text, the learner concentrates better on learning the content from the combined presentations (Sweller et al., 2011). Such findings could have important implications for graphical presentations in a complex knowledge domain such as accounting.

A meta-analysis of the split-attention effect has revealed its robustness across many experimental settings (Ginns, 2006). Fifty independent studies used in Ginns' (2006) study revealed that, across a variety of learning domains and instructional formats, the split-attention effect is robust. The split-attention effect (e.g. Florax & Ploetzner, 2010; Rose & Wolfe, 2000) can arise because information is temporally separated also known as temporal contiguity effect (Ginns, 2006) or spatially separated, referred to as spatial contiguity effect (e.g. Clark & Mayer, 2008; Mayer, 2005). Studies have shown that students learning is enhanced when complex instructional material is devised to reduce time (temporal contiguity effect) or the space (spatial contiguity effect) between disparate but related components of learning content.

There are very few studies that have examined the effect on a learner when forced to search and mentally integrate related information that is incomprehensible in isolation due to the way the content is designed in accounting (Sithole et al., 2016). The practice of having separate text and diagrams seems to be the accepted convention, and yet the effectiveness of this presentation in a learning area such as accounting is seldom questioned. Conceivably this presentation is based on a realisation that this cognitive load theory concept could provide a solution to the challenges frequently highlighted in the accounting discipline. As various studies have demonstrated better understanding of material happens when presented in an integrated form rather than a split format presentation, we developed the first hypothesis as follows:

> *H1 Participants in the integrated format group (group 1) will give more accurate answers than participants in the split-attention format group (group 2) on recall tests and transfer test items.*

Mental Effort and understanding accounting instructional material

As was pointed out in the foregoing, promoting a better understanding of financial accounting can only be brought about by well-designed instructional materials. For example, accounting textbook writers have attempted to expose first-year accounting learners to many possible transactions that they may encounter; expanding principles of accounting textbooks to the extent of information overload (Boyd et al., 2000). Cognitive load is increased by the need to mentally integrate various sources of information (Ayres & Sweller, 2005). Hence learners studying split-attention material should report higher cognitive load than students studying integrated formats. Empirical findings on mental effort in cognitive load theory (CLT) has established that using well-developed instructional material, which takes into account CLT principles would not only improve test performance scores in recall and transfer items but lower investment in mental effort (Paas, 1992; Paas & Van Merriënboer, 1993; Paas et al., 2003). This has been achieved by designing instructional material with a lower extraneous cognitive load on the learners which leaves capacity for mental resources to deal with other aspects of learning. Therefore the mental effort hypotheses posit that:

> *H2 Students in the integrated format (group 2) would report lower cognitive load than students in the split-attention group (group 1).*

The Current Study

Based on the above discussion, the current study examined the hypothesised superior learning outcomes of integrated instructions over conventional split-attention instructions. To test the hypotheses, an experiment was conducted.

Method

The aim of the Experiment was to inquire into the split-attention effect in the accounting instructional materials. Secondly, the experiment sought to test whether instructional material with text as close as possible to the associated diagram could lead to higher learning performance than the traditional split-attention condition. In this study we also tested whether separate text and diagrams would present a higher load than integrated text and diagrams.

Participants

A total of 91 first-year post graduate students from an Australian university enrolled in a financial accounting course participated in the study. In total, 55% male and 45% female students (50 males and 41 females, *M* = 23 years old, *SD* = 2.25) were randomly assigned to one of the two conditions. There were 45 students in the split-attention group (group 1; 26 males and 19 females, *M* = 23 years old, *SD* = 2.79) and 46 students in the integrated group (group 2; 26 males and 20 females, *M* = 22 years old, *SD* = 1.59). Students participated voluntarily in the study, and were not paid for participation.

Before conducting the experiment, the pre-test questionnaire collected information about each participant's age, gender, first language, and knowledge of accounting. The 91 participants in gender ranged from 52% to 47% males, and from 53% to 48% females in each instructional format group. Participants' gender homogeneity was apparent across the groups. All students had passed a formal English language examination. Although English is a second language to most participants, the language proficiency was sufficiently high to respond to questions in English.

Materials

The instructional material was based on Weygandt et al. (2010). The topic of the basic accounting equation, which included debit and credit rules and their effect on the basic accounting equation was selected because students were scheduled to study the subject matter during the subsequent weeks. The instructional material were adapted to meet the needs of the instructional formats. The instructional material for the split-attention format (group 1) was similar to those of the textbook. An example is illustrated in Figure 1.

The instructional material for the integrated format (group 2) was presented in a format that brought the text as close as possible to the diagram (see Figure 2). The content was reformatted to decrease split-attention by bringing the text as close as possible to the diagram (integrating). The integrated material was developed after reviewing the research concerning split-attention (e.g., Agostinho et al., 2013; Ayres & Sweller, 2005; Roodenrys et al., 2012; Tindall-Ford et al., 2015) and then reformatting the instructional material. An example is illustrated in Figure 2.

At the start of the experiments participants completed a pre-test questionnaire. They received two A3 pages of learning materials that contained learning instructions. The learning instructions differed among the two groups. During the test, as they completed the test questions they also responded to mental effort rating questions.

Procedure and Tasks

Approval for human subjects research was obtained from the Human Research Ethics Committee at the Australian university prior to consenting participants to the study. Participants were given participant information sheets and consent forms. They signed the consent form stating their written agreement to take part in the study. The material was presented to each group on A3 sheets of paper so that the participants were able to view all the learning content on one sheet of paper.

A pilot study was conducted before the first experiment. It aimed at refining instructional guidance, instructional content, and time that should be allowed for each phase of the studies. Five students from the same university took part. Those five students did not participate in the main experiment. The time limit, for both the learning phase and test phase, was determined in a pilot study.

The experiment included three phases conducted during the teaching of financial accounting to university students in the first semester. In the first phase participants provided information about their age, gender, language, and knowledge of accounting. This took 10 minutes. The time limit, for both the learning phase and test phase was determined in a pilot study. The time given to complete the test was strictly controlled to avoid the possibility of a systematic difference in processing time between the split-attention and the integrated group. Research has demonstrated that processing time is positively related to recall (Barrouillet et al., 2007). In this study, efforts were made to ensure equality of processing time across the two groups. In the learning phase, the participants were given 15 minutes to review the learning materials provided to them. In the final phase, students completed a test that was formatted as a single sided A4 booklet. The test consisted of recall and transfer items. The participants were given 45 minutes to complete the test.

The test consisted of 28 recall and 11 transfer items. An example of a recall question in the test phase required students to write the basic accounting equation. Recall questions requires a student to retrieve information that has been learned (Carpenter, 2012). Transfer questions were more challenging and demanded the students to apply what has been learned during instruction to a new problem solving situation.

Participants provided mental effort ratings after the learning phase and after attempting every question as outlined by Paas (1992). Participants wrote answers and any comments they wished to provide on the blank spaces immediately below the questions. The researcher collected all the test booklets soon after the students completed the tasks.

Rating of Mental Effort

Students were asked to rate the cognitive load associated with the learning task. This study used Paas et al. (2003) 9-point subjective cognitive load rating scale to measure perceived cognitive load. This is an established scale to measure levels of cognitive load (Ayres & Paas, 2012). This method seems to be the preferred method in most recent research. However, it should be noted that two main subjective rating scales have commonly been used in CLT research. One that has been used in most early research is mental effort rating scales (Paas et al., 2003; Van Gog & Paas, 2008), which ask learners to rate the amount of mental effort they have invested in completing a task on a 9-point Likert scale, ranging from "very, very low mental effort" to "very, very high mental effort". The second widely used subjective measure of cognitive load is the rating of perceived task difficulty (Paas et al., 2003), which asks learners to rate their perceived difficulty of a task on a 9-point Likert scale, ranging from "very, very easy" to "very, very difficult". As Schmeck, Opfermann, Van Gog, Paas and Leutner (2015) state, while perceived task difficulty and perceived mental effort may correlate, they are different constructs (also see Van Gog & Paas, 2008).

With this in mind, perceived mental effort rating was chosen as it is one of the measures that has widely been used in various cognitive load studies since the early development of CLT (Paas et al., 2003; Van Gog & Paas, 2008). Mental effort rankings were solicited from participants at the end of the learning phase and after each question in the test. For example, "How much mental effort did you invest for you to learn the material?" at the completion of the learning phase and 'How much mental effort did you invest to answer this question?' at the end of each test question. The ratings on the levels of mental effort of the accounting exercises are assumed to assess cognitive load indirectly (Paas et al., 2003; Van Gog & Paas, 2008).

Results of the Experiment

The two instructional formats were the major factor of interest. Three separate ANOVAs were used to determine the effect of the two instructional formats on participants' performance on recall, transfer, and perceived cognitive load as dependent variables. Alpha was set at .05 when evaluating tests of statistical significance.

The data were analysed with a one-way analysis of variance (ANOVA) with code 1 and 2 representing each group as the between-subjects factor. The perceived amount of mental effort during the specific instruction and the recall and transfer test performance were the dependent measures to determine if the treatment groups differed. The alpha was set at .05 ($p < .05$) when evaluating tests of statistical significance. To measure effect size, Cohen's d was calculated, with values of .10, .30, and .50 characterizing small, medium, and large effect sizes, respectively (Cohen, 1988).

Pre-test Response and Analysis

A one-way analysis of variance (ANOVA) was conducted on pre-test responses to explore differences across the two groups involved in the Experiment. Means and standard deviations are shown in Table 1.

Table 1. *Means and Standard Deviations for Pre-test Responses, Recall and Transfer Test Scores as a Function of Instructional Condition*

			One Way ANOVA	
	Mean	SD	F	*p*
Pretest				
Age				
Split-attention group (n = 45)	23	2.79		
Integrated group (n = 46)	22	1.59	(1,89) = 0.020	.071
Knowledge of accounting*				
Split-attention group (n = 45)	2.13	0.40		
Integrated group (n = 46)	2.04	0.29	(1,89) =0.228	.653
Recall**				
Split-attention group	58.56	12.70		
Integrated group	80.19	12.59	(1,89) = 66.576	< 0.05
Transfer***				
Split-attention group	34.84	24.94		
Integrated group	69.87	21.29	(1,89) = 51.983	< 0.05
Mental effort rating				
Learning Phase				
Split-attention group	6.33	1.74		
Integrated group	4.00	1.76	(1,89) = 40.227	< 0.05
Mental effort Rating on instruction				
Recall				
Split-attention group	7.42	0.98		
Integrated group	2.93	1.28	(1,89) = 346.128	< 0.05
Transfer				
Split-attention group	5.84	0.90		
Integrated group	3.95	3.19	(1,89) = 14.553	< 0.05

Notes: *Actual responses were 1 to 5 for knowledge of accounting. **Actual raw score ranges were 0 to 28 for recall, and for ***Transfer it was 0 to 11. SD = Standard deviation.

The one-way ANOVA for pre-test questions demonstrated no significant main effect of group for age; $F(1, 89) = .02$, $p = 0.888$, and knowledge of accounting $F(1, 89) = 1.471$, $p = .228$. The equivalence of knowledge of accounting between the groups was important to note, as no group came to the study with higher a priori knowledge of accounting. This is evidence that the two groups are equivalent on significant demographic dimensions. Accordingly any statistically significant differences detected later are more likely due to the different treatment conditions.

Mental Effort Ratings

Means and standard deviations for learning phase of mental effort ratings are shown in Table 1. Results from the one-way ANOVA for mental effort invested in the learning phase indicated significant differences across the two formats, $F(1, 89) = 40.227$, $p < 0.05$, $d = 1.33$, indicating a large effect size. Consistent with predictions, there were large and significant between-group differences on mean mental effort rating on learning results. Mean learning phase ratings showed that the integrated group reported lower levels of cognitive load than the split-attention group.

Performance Measures

Table 1 shows means and standard deviations for performance measures in the experiment based on one-way ANOVA. A one-way ANOVA for recall scores showed a significant main effect for the recall test items; $F(1, 89) = 66.58$, $p < 0.05$, $d = 1.71$, indicating a large effect size. Mean recall scores showed that group 2 (the integrated format) had higher scores than group 1 (the split-attention format). The one-way ANOVA for transfer questions also demonstrated a significant main effect of group; $F(1,89) = 51.983$, $p < 0.05$, and $d = 1.51$, indicating a large effect size.

Mental Effort Rating on Instruction

After the learning phase and after each test question, students were asked to rank their effort in terms of perceived mental effort on recall and transfer questions. A one-way ANOVA was conducted to determine the influence of instructional methods on recall and transfer test performance.

Table 1 also shows the mean ratings and standard deviations for the ratings of the test phase. Consistent with predictions, there were large and significant differences arising from different instructional formats based on mean values of recall results; $F(1,89) = 346.128$, $p < 0.05$, $d = 3.90$, indicating a large effect size. The differences from instructional formats also influenced the mean values of transfer results; $F(1, 89) = 14.553$, $p < 0.05$, $d = 0.80$, indicating a large effect size. The perceived cognitive load was significantly lower in the integrated format group than in the split-attention format group.

Summary and Discussion of the Experiment

In the Experiment, the finding of significantly higher transfer performance scores by students in the integrated group compared to those in the conventional split-attention group was clearly evident. The superiority of the integrated group might have resulted from the integrated text and diagrams. The requirement to mentally integrate text with relevant aspects of the diagram by the split-attention group, might have contributed to poor performance by the split-attention group.

The results of performance scores on transfer items are similar to those found by Roodenrys et al. (2012), and Tindall-Ford et al. (2015). Such superior performance had been demonstrated, for example by Roodenrys et al. (2012), with Australian students studying educational psychology, by showing slightly increased accuracy of students in the integrated group over split-attention group with transfer test items. Interestingly, the results of the current study show better performance on both recall and transfer tasks.
The experiment reported in this study showed a strong benefit of integrating instructional material when compared with the split-attention format which had not been observed in most previous studies. Possible reasons for this include the fact that many studies conducted on the split-attention effect involved small sample sizes and short treatment time lengths. Hence the current results strongly suggest that providing students with integrated material prior to learning new content would result in effective learning.

General Discussion

The aim of this study was to investigate the effect of split-attention on novice students by administering instructor manipulated paper-based instructional materials on learning accounting. This was examined in an experiment with accounting materials.

The major finding from this study relates to the students' ability to learn better with integrated materials than by instructional material that requires them to split their attention between diagram and text. The accounting instructional materials demonstrated split-source format and this has a negative effect on learning. The study showed that when split attention was managed by the instructor by integrating text and diagrams, students consistently outperformed those in the split-attention group.

In terms of mental effort (perceived cognitive load) experienced during learning, there were significant differences across the two groups. Participants studying the integrated format consistently reported lower cognitive load than the split-attention format. Our hypotheses were confirmed as students studying under the integrated format incurred significantly lower cognitive load than students studying under the split-format group.

Implications for Instructors and learners

In formulating instructional prescriptions from the present research, we took into consideration previous findings such as those by Roodenrys et al. (2012) who concluded that managing the split-attention format enhances performance. It is important to note that in the current study, the benefit of integrated material may have been more apparent because participants learned from instructional materials that had text in very close proximity to the diagram.

In light of these recent findings, the results of the present study support the conclusion that instruction with emphasis on integrated instructional material is an appropriate alternative to conventional split-attention instruction. At the same time, caution is needed when undertaking this strategy since other studies have concluded that the integration strategy has to be carefully implemented in order to enhance learning (e.g., Roodenrys et al., 2012; Tindall-Ford et al., 2015). For example, integration has to be undertaken on instructional material if the text and diagram cannot be understood in isolation.

Many of the learning activities that accounting students engage with in the classroom, whether related to problem solving, reading, calculations impose considerable burdens on the limited capacity of working memory. These activities often require a student to hold certain pieces of information in mind such as text while at the same time attempting to match with relevant parts of a diagram. According to cognitive load theory and as the results of this study show, is mentally challenging and does not enhance learning, yet these are the kinds of activities which novice learners struggle with. Therefore instructors need to design instructional material that is already integrated.

The studies reported were conducted in a controlled experimental setting but the the instructional implications may be wide-ranging. Universities offer learning services that are accessible to both students and staff. These offer courses or workshops that assist in navigating the university environment. Such services can provide students with illustrations of split-attention material which could enable them to employ effective strategies when dealing with split-source instructional material. Such practical skills can be taught to students in a university setting.

Instructional Implications for Textbook Writers

Numerous examples exist of instructional material not designed according to cognitive load theory principles in the area of introductory accounting. Students often encounter instructional material such as the statement of financial position or a statement of cash flows, with a diagrammatic representation with text below or above the diagram. An alternative instructional presentation would be to have the text embedded in the diagrammatic presentation which, as this study has shown, would reduce the extraneous cognitive load and enhance learning.

Another conventional way of presentation, again using the example of a balance sheet, is to visualise the balance sheet in the form of an equation. The equation explained within the text would be that total assets equals liabilities plus owners' equity. Looking at the equation in this way shows how assets were financed; either by using the owners' money (owners' or shareholders' equity) or by borrowing money (liability). However, most balance sheets do not have the equation depicted, and students are usually forced to have a mental representation of the equation in their minds as they try to make sense of the assets in one section and the liabilities and net worth in the other section which would make the sections "balance". Such type of presentation exerts an unnecessary load on working memory.

Conclusion

In conclusion, the results of our work is very promising for an area of "split-attention effect" in accounting. We found the existence of split-attention effect in accounting. In addition we found that split-attention has a negative effect on learning. Theoretically, this has important implications with regard to evidence that learners should learn instructional material that is integrated. From a practical perspective, these results are important for students, instructors and textbook writers.

Despite the potential revealed by this study, for split-attention to be successful, the onus still rests with the instructor to design and use instructional material that reduces the cognitive load for the students. At the same time, the research also raises new questions about the need for further research to establish the possibility of the students managing their load by rearranging the instructional material. Future research is also needed to find other methods students can be instructed to use in order to integrate separate text and diagrams to enhance learning.

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