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Testing and self-management of cognitive load in accounting. A case example of Zimbabwe university students

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Description

Previous research using Cognitive Load Theory (CLT) has established the importance of integrating a diagram and the relevant text in instructional material. It is widely acknowledged that cognitive load theories play an important part in facilitating the structure of learning materials in physics, biology, mathematics, accounting, and other related disciplines. What has not been established is whether self-management of split attention (separated diagram and explanatory text) by learners has any effect on learning. In Zimbabwe learners have been exposed to a wide range of instructional format. However, the need to improve learning persists. The importance of students taking control of their cognition will be investigated using university accounting students from Zimbabwe. The techniques accounting students can use to manage their cognitive load using spilt attention learning material will be investigated. Analysis of the data using ANOVA which will involve computation of statistical measures to determine the differences between the groups selected.

Location

Innovation Campus, Building 233, Rm G12

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Abstract

Previous research using Cognitive Load Theory (CLT) has established the importance of integrating a diagram and the relevant text in instructional material. It is widely acknowledged that cognitive load theories play an important part in facilitating the structure of learning materials in physics, biology, mathematics, accounting, and other related disciplines. What has not been established is whether self-management of split attention (separated diagram and explanatory text) by learners has any effect on learning. In Zimbabwe learners have been exposed to a wide range of instructional format. However, the need to improve learning persists. The importance of students taking control of their cognition will be investigated using university accounting students from Zimbabwe. The techniques accounting students can use to manage their cognitive load using spilt attention learning material will be investigated. Analysis of the data using ANOVA which will involve computation of statistical measures to determine the differences between the groups selected.

1. Introduction

Previous research has established the importance of integrating a diagram and the relevant text in instructional material. Separate text and diagram result in a split attention which has a negative effect on learning (Agostinho, et al., 2013). When instructors integrate formulas with diagrams, learners find it easier to integrate and process both forms of visual information and in turn performed significantly better (Chandler and Sweller, 1991; Chandler and Sweller, 1992). .

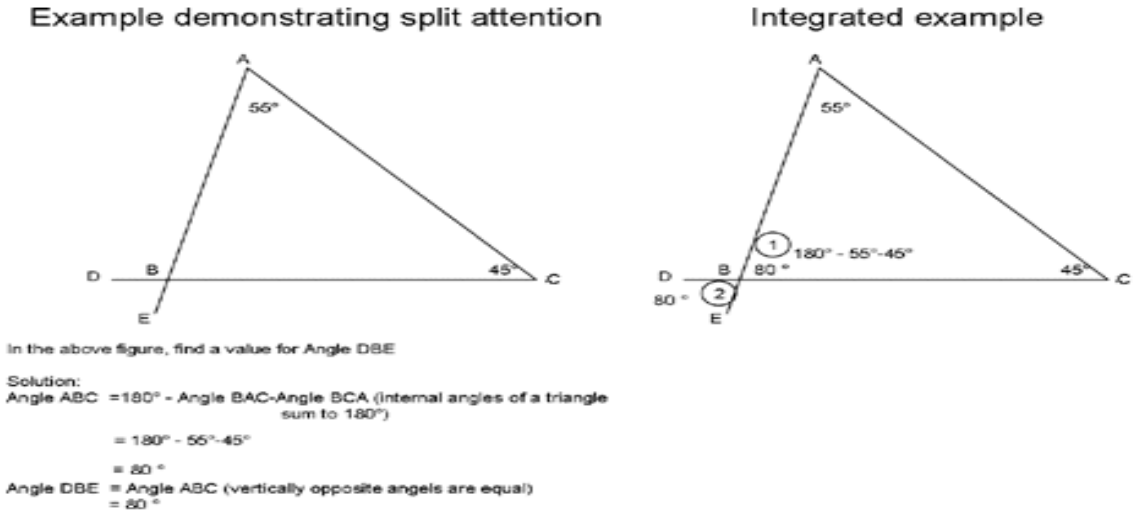

Figure1.1: *split attention and integrated example*

In the examples above, the left example produces split attention because of the separate diagram and text, however the right example enhances learning because it guides the learner's attention through the worked example. The right example is a typical integrated example. The split-attention effect is a form of cognitive load that instructional designers should avoid.

This is guided by the Cognitive Load Theory (CLT) research which has provided guidance on the most effective instructional format when teaching students at universities. It is based on the idea that learners have limited memory and the proper allocation of the available cognitive resources is vital to learning. The main basis for the use of cognitive load theory is for the provision of a framework for the proper design of instructional material. For example, the usage of worked examples that are properly structured should be supported since this instructional strategy assists students in making efficient use of their working memory and develop powerful structures in long term memory called schemas (Chinnappan and Chandler, 2010).

Pedagogical methods can be traced as far back as the early twentieth century, with Edward Thorndike, Lev Vygotsky, and John Dewey generally considered as the prominent learning theorists during that time, whose ideas contributed to the development of major schools of thought and pedagogical applications we have today (Mostyn, 2012). Firstly, behaviourism was widely implemented for nearly twenty years but for the most part abandoned today. This was followed by constructivism. This school of thought also emerged during the early twentieth century and is still prominent today. Constructivism states that humans construct their knowledge and their understanding of reality primarily in the context of personal experiences and social interactions, which unavoidably mediate the outcomes of any learning process (Mostyn, 2012). Contemporary pedagogical methods knowingly or unknowingly are based on constructivist theory. All constructivist methods emphasize an instructor's role, primarily as that of a coach and facilitator who decide the course topics, and engage and advise students interactively.

Important shortcomings have emerged from these early theories. Most noteworthy has been the inability to demonstrate a learning efficiency benefit of constructivist methods in controlled studies. In fact, randomized, controlled experiments by cognitive load researchers have repeatedly demonstrated that the constructivist methods would usually inhibit learning efficiency (Kirschner et al. 2006; Sweller et al. 2007; Mayer 2004). The application of cognitive load theory has shown that the studying of worked examples is a more effective alternative to problem solving. Studying a number of problems can reduce extraneous cognitive load and can facilitate learning. Sweller and Cooper (1985) established the dominance of worked examples over solving problems using algebra transformation problems. Recent research has established that worked examples may be best suited for novices and not experienced learners (Kalyaga, et al. 2001). As learners gather more knowledge, they become experts and under these circumstances worked examples need to be replaced with problem solving exercises.

Further investigation has also revealed that integration of worked examples (diagram and solution) were much more beneficial than the split format (Tarmizi and Sweller, 1988). Subsequent research has confirmed the superiority of integrated worked examples as compared to split format learning material such as in: electrical engineering (Chandler & Sweller, 1991); instruction of computer software (Kalyuga, et al., 1999), and in music instruction (Owens & Sweller, 2008). Chandler and Sweller (1991) found that where it is not necessary to integrate, results showed that integration was no better than split source instruction. In fact, seemingly useful but not essential information can have deleterious effect even when presented in integrated form. Chandler & Sweller's (1991) last experiment showed that the need to integrate is necessary if the individual units cannot be understood alone.

The issues of self-management of cognitive load have followed investigation of split attention research. It has been established that the integrated instructions provided by a lecturer or instructor is the most efficient method for dealing with split attention (Roodenrys, et al., 2012). Roodenrys, et al. (2012) further state that it is also increasingly becoming clear that students need to take control of their own cognition, learning and experience independence. In universities, accounting graduates need to leave universities and colleges well prepared to make critical decisions in a constantly changing environment (Rezaee, et al, 2005).

In Zimbabwe, before independence in 1980, robust educational structures produced high quality graduates and research (Kariwo, 2007). Despite the massive expansion of the education system since independence, issues of equity, quality and access continue to persist. Consequently, education reforms from 1990 to 2001 focus on the relevance and quality of education and training through new approaches to content, technologies, and skill provision in high schools (Mumbengegwi, 2001). Technical education programs shifted their focus from labour-specific, skill oriented programs to technical education of a general nature, with an emphasis on design and technology.

On educational culture, there is a developing trend of the absence of failure at universities and the growing tendency by students to an entitlement mentality. Researches on the relevance of culture and its relationship to accounting have been investigated over the years (Wallace, 1990; Fechner and Kilgore 1994). Prior research has identified the relationship of accounting with the needs of developing countries, even suggesting that if accounting environments differ among countries, then accounting must also differ amongst these countries (Choi and Mueller, 1992). The political landscape, educational reforms as well as the institutional specific issues of students, faculty and society have affected accounting education in Zimbabwe. These developments have given rise to varying student's educational experiences at the university level. As a result, students have been exposed to a wide range of instructional formats provided by lecturers at universities. Among the most common teaching methods has been: the use of lectures; interactive sessions; tutorials; delivering of lectures supported by a web-based learning environment; problem solving exercises, and worked examples.

2. Review of related literature

A growing body of literature addresses specific aspects of cognitive load and instructional material (Sweller and Chandler, 1994; Paas, et al., 2004). Little emphasis has been placed on self-management of instructional material by students. This study is going to focus on testing the existence of split attention and investigating the techniques students can use to manage cognitive load when faced with split attention material.

Cognitive Load Theory

Cognitive load theory is based on human cognitive architecture (Sweller, et al., 2011). It states that there is a working memory which has limited capacity. There also exists an unlimited long-term memory where information is stored in the form of schemas. It is from this theoretical framework that a variety of strategies have been developed to reduce the load placed on a learner's working memory so as to provide better learning opportunities. Therefore an understanding of the different loads is essential.

Types of cognitive load

Intrinsic, extraneous and germane loads are the three types of cognitive load that can be imposed on students.

Intrinsic load

Intrinsic load refers to the complexity of a task relative to an individual learner. Learning to memorise the basic accounting equation such as A=E+L, is a task that will impose a low intrinsic load because it is low in complexity. In order to process this accounting equation, students need to consider the various elements of the information in isolation and would not necessarily concurrently process any other data. Such type of information is referred to as a low element interactivity task (Sweller and Chandler, 1994). However, applying the same equation (A=E+L) to a new accounting problem would need the learner to relate and compare parts of the formula with the other learning aspects in the problem. Such types of tasks are high in intrinsic load.

Chinnappan and Chandler (2010) noted that in mathematics, some tasks may require heavy cognitive load whilst other less complex tasks involve little cognitive load. Therefore when a task exceeds the mental resources available in working memory a cognitive overload occurs. Mathematical tasks have high intrinsic load because of the high element interactivity and in some cases low intrinsic load where low element interactivity occurs. Chinnappan and Chandler further stated that the intrinsic load and the degree of element interactivity is also dependent on the learner. A low intrinsic task for a mathematics teacher could pose a very high intrinsic load for a student. Instructors need to be aware of the intrinsic load that is associated with any task. Mayer and Chandler (2001) suggest that some tasks may need to be segmented into sub tasks in order to control the intrinsic load.

Extraneous load

An extraneous cognitive load (Sweller and Chandler, 1994) is the one caused by the design and organisation of the learning material and not by the intrinsic nature of the task. Students engage in irrelevant cognitive activities involving a lot of simultaneous element interactivity mainly because of the way the task is organised. An irrelevant cognitive activity is any activity not directed to schema acquisition. Therefore a more appropriate organisation of information is essential through the elimination of irrelevant cognitive activities which will reduce extraneous cognitive load hence facilitating learning.

Germane Loads

Activities that involve cognitive load and effort directly relating and contributing to schema development and automation are referred to as Germane Loads (Chinnappan and Chandler, 2010). Germane activities often include among other things, self-explanations (Chi, et al. 1989).

Cognitive load theory and learning instruction

Numerous studies have discussed cognitive load theory in a range of disciplines and publications have been made in a wide range of journals. These include electrical engineering and biology instructional materials (Chandler and Sweller, 1991), geometric optics and kinematic (Ward and Sweller, 1990) to the teaching of statistics (Lovett and Greenhouse 2000). Debates regarding the usefulness of problem solving and worked examples have been going on over the last few years as highlighted by Sweller et al. (1989), Tuovinen and Sweller (1999), Sweller (1999), Kalyuga, et. al (2001). Prior research on the need to include cognitive psychology and the learning of accounting as well as the effort measures needed when analysing student's learning strategies have been noted by Libby and Tan (1994), Cloyd (1997), Bryant and Hunton (2000).

The different studies in the literature show that cognitive load theory can offer guidance in the in the design of instructional material. It also reveals that the extant literature on the application of cognitive load theory in accounting education to developing countries is scarce, and that very little discussion has appeared in accounting education (Mostyn, 2012). This research therefore asserts that more studies of developing countries are essential if the issue of cognitive load theory in accounting education is to be explored further meaningfully. According to Peasnell (1993) Accounting is an applied discipline which is strongly influenced by the environment in which it is embedded.

3. The statement of the problem

The most common traditional learning material consists of a diagram accompanied by an explanatory text. The diagram is separated from the text and having two sources of information results in a negative effect on learning (Agostinho, et al., 2013). In cognitive load theory, the separation of text and diagram is referred to as the split-attention effect (Chandler & Sweller, 1992). Split format material has been found to have an unnecessary high degree of element interactivity, which imposes a heavy extraneous cognitive load that interferes with learning for students (Sweller and Chandler, 1994). Few, if any studies have been conducted that investigate how students can manage the split format on their own. Although instructors can modify instructional material during lectures and when issuing articles to read, students still meet the split format material in various areas such as books, journals and on the internet, therefore management of this content is crucial to enhance learning and reduce extraneous cognitive load.

The current accounting education environment in Zimbabwe is characterised by the traditional lecture, consisting of working out problems, interactive lectures, assignments, large classes and a large section of the curriculum that has to be covered within a semester. All this is set in an educational environment where students are eager to learn and there is increasing enrolment. The universities are focusing on quality in a complex cultural setting where students feel they are entitled to a degree, with some proponents advocating for the absence of failure in universities.

On the other hand employers now require graduates who can quickly adapt to new accounting requirements (e.g. standards), changes in accounting packages, and the ability to use advanced information technologies (ICAZ, 2013). These challenges require adaptation from academics and students so that the chosen learning strategies can influence the development of an in-depth knowledge of the subject being learnt. A significant body of research has shown that the method of providing the learner with a diagram and text that is integrated effectively deals with split-attention because the learner will not be required to perform search and match tasks (Ginns 2006). What has not been established is whether self management of split attention by learners has any effect on learning.

4. Anticipated impact and significance of the study

Despite the growing interest in cognitive load research, few studies have investigated cognitive load and accounting instruction (Mostyn, 2012). Where researches have been done, these discussions are few and far between (Amernic and Enns, 1979; Mostyn, 2012). On the other hand, there is dearth of research in Southern Africa (a developing region), particularly on directly exploring cognitive load theory and accounting education in the Zimbabwean context. Therefore, there is need for additional research.

Furthermore, accounting education issues are well documented in developed countries (Albrecht and Sack, 2000; Chaffey, et al. 2011), although some are contradictory (Albrecht and Sack, 2000). The study will specifically investigate the novel area of self-management of cognitive load in the accounting discipline. There is no known research that has investigated how students self-manage their cognitive load in the accounting curriculum. This research will provide real experimental data to assist students, academics and institutions to take corrective measures when faced with spilt attention learning material.

This will assist students to understand the subject content better. There has been a lot of discourse regarding how students should be taught in universities. It is equally important to determine how accounting students can develop skills to manage their own learning activities and hence reduce their cognitive load. This is vital as most of the material students encounter in textbooks, journals and on the internet is presented in split format and not integrated, therefore it is difficult for students to effectively learn. While the research will be context-specific, as it will use Zimbabwean participants, its findings will nevertheless resonate with all institutions offering accounting education. The research will increase awareness in the accounting discipline, of an important and relatively new development in cognitive psychology. This is particularly important for some introductory subjects in accounting and for a few advanced complex tasks as the cognitive load theory provides specific instructional designs for improving learning efficiency. Although cognitive load theory research has assisted the instructional design for many other disciplines, very little discussion has appeared in accounting. Therefore the research will also be a worthwhile addition of literature in the accounting discipline.

5. Study delimitation

The study will only explore how learners can effectively manage the split attention learning material in the context of cognitive load theories in Zimbabwe. It will not seek to analyse or recommend other cognitive load strategies nor will it seek to discuss the appropriate teaching methodologies.

6. Research hypotheses

The hypothesis is that students who are given guidance on how to self-manage cognitive load when presented with split attention instructional materials will perform better than students given split attention instructional materials without guidance.

7. Research methodology

This section describes how the research will be carried out. The methodology refers to the overall approach evident in the research process from the theoretical foundation to the strategies that are used in the collection and analysis of the data (Hussey and Hussey, 1997). Methods, in contrast refer to the specific means by which data is collected and analysed. Consistent with the research methodology and methods, this section consists of the research design, how the data will be collected, sources of data and finally how the data will be analysed. The research design and methods that will be used are critical since they will affect the final research findings.

Research design

The research will follow a positivist paradigm. It will involve the use of numerical measurements and statistical analysis. The positivist research approach was chosen because it places great premium on objectivity and reliability of findings as well as encouraging replication. Therefore, quantitative methods were considered prudent to

examine the techniques accounting students can use to manage their cognitive load using spilt attention learning material. A recognised theory (cognitive load theory) will provide the variables to be tested quantitatively. The researcher will follow Mertens (2005) advice that experiments are the design of choice in the education field. The value of using experiments is that they will enable the researcher to uncover and gain access to information and insights previously hidden and consequently posit interesting outcomes.

Experimental design

This research seeks to manipulate the independent variable/factor (cognitive load), which has a number of different levels. (use of self-management, integration and split attention) in order to observe the effect on the dependant variable (test scores). The experimental design will involve a selection of subjects, random assignment of the subjects to experimental and control groups and the exposure of the experimental groups to the independent variables which will be withheld from the control group and finally the evaluation of the three groups on the dependant variable.

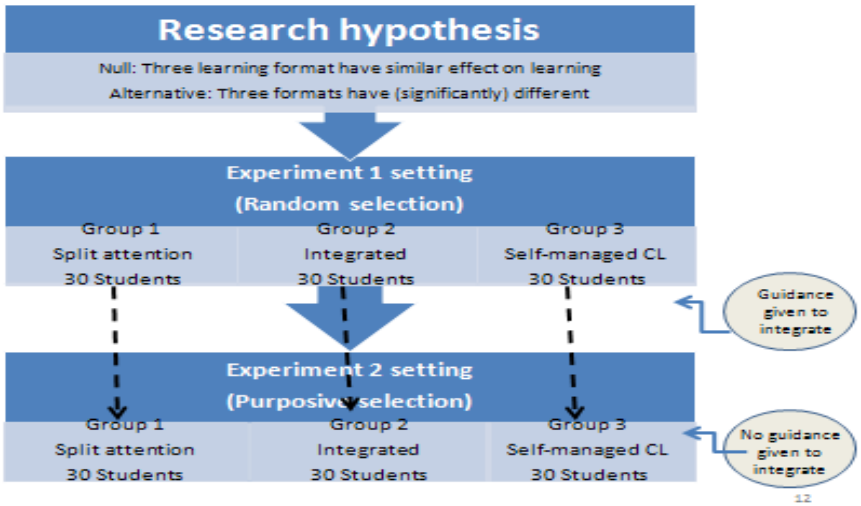

Figure 7.1: Design of the study

As shown in figure 7.1, the subjects will be assigned to one of the following conditions: Group 1, split attention - conventional split attention formatted instructional materials; Group 2, instructor managed cognitive load - Integrated instructional materials; Group 3, self-managed cognitive load – conventional format and given guidance on how to manage the split attention. The first experiment (Experiment 1) will be confirming the existence of the split attention. Group 1 will be the control group. Comparisons will be made that will establish whether the second group is superior to the first, also testing whether the guidance provided to students to self-manage the split attention would lead to better performance than group one, the conventional split format group.

Experiment 2 will use the same instructional materials that were used in Experiment 1. This will be extended to include a transfer task that will examine if the group 3 participants would apply their knowledge to a new learning environment. The second part of experiment 2 will see students being given a new set of instructional materials with clear split attention.

Subjects.

The subjects will be 90 first year undergraduate students from a Zimbabwean university. The university will be selected on the basis that it is the only university

where the researcher has access to students based on a previous working relationship with the university. Ninety is the average class size of students in a first year course, therefore all students in the first year are expected to participate. The participants are expected not to have learnt the content in the test, however they would have basic knowledge of accounting obtained from their high school studies. The participants will be randomly allocated to any of the conditions to form 3 groups.
To enable meaningful comparisons to be made, as far as possible, equal groups would be created. The students will be informed of the general nature of the experiment and the requirements for participation.

Ethics application
The research will involve gathering data on human subjects. Only written and verbal responses are expected from the research, hence no major physical, mental or distressful effect is anticipated.

Procedure:

Experiment 1

1. The participants will be asked to review the materials for 10 minutes (learning phase).
2. A post-test will follow. The test will have recall, near transfer & far transfer items.
3. Mental effort ratings will be asked from participants.

Experiment 2

Will measure the transferability of the split-attention self-management skills. Experiment 2 will be structured into two parts. The aim of Part 1 will be to replicate the split-attention effect. The aim of Part 2 will be to test whether the self-management skills acquired by Group 3 would be transferable to a new learning domain. Part 1 of Experiment 2 will have a similar hypotheses as Experiment 1.

For Part 2 of Experiment 2, it will be hypothesised that participants allocated to Group 3 in Part 1 of Experiment 2 would transfer self-management skills to the new split-attention instructional materials, leading to a reduction in extraneous load and therefore outperforming Group 1 (hypothesis 2). If the skills would be transferred, it will be hypothesised that they would enhance learners' performance on post-test measures.

Data presentation and analysis procedures

The independent variable will be the instructional condition and the dependent variables under analysis will be the test performance scores of student's understanding of the double entry system and mental effort ratings. Test scores will include recall and transfer questions and the mental effort ratings that will be recorded for instruction, recall, and transfer. The test marks will be double checked for errors. A one-way, between-subjects analysis of variance (ANOVA) will be conducted on test performance scores (means and standard deviations) as well as the mental effort ratings (means and standard deviations). An alpha level of 0.05 will be used as the criterion for determining statistical significance.

In these experiments, we have more than two groups, therefore the use of ANOVA will be preferred. Analysis of variance (ANOVA) involves one independent variable/factor (cognitive load), which has a number of different levels. These levels correspond to the different groups or conditions which in this case is: 1. conventional split attention formatted instructional materials; 2. integrated instructional materials, and 3 self-managed cognitive load with guidance on how to manage the split attention.

9. Expected outcomes

It is expected that the experiments will confirm the existence of split attention and that students who self-manage their instructional material will show superior performance as compared to the other two groups; split attention group and integrated instructional format group. This will imply that if students are taught and when faced with split attention instructional material, they should be able to manage their cognitive load and therefore their learning is better under self –management.

10. Limitations of the study

In undertaking this research, the researcher acknowledges that: Participants may attempt to respond in a pre-determined way to satisfy the researcher; Learner's pre-existing cognitive learning strategies are not controlled.

11. Contributions of the thesis

Firstly, the research will provide empirical evidence on how accounting students can self-manage their cognition using spilt attention learning material. Secondly, the thesis will provide an interesting data set (case of Zimbabwe); Zimbabwe is a developing country with a different educational culture. Finally, the research will make a contribution by providing incremental research literature since Learners are increasingly accessing information online, in textbooks. Therefore, research that provides empirical evidence to learners on how they can self-manage cognitive load will be a worthwhile addition to CLT research.

17. References

Albrecht, W. S., Sack, R.J. (2000). "Accounting education: Charting the course through a perilous future." Journal of Government Financial Management 51(1): 58-59.

Amernic, J. H., Enns, R.J. (1979). "Levels of cognitive complexity and the design of accounting curriculum." The Accounting Review LIV(1): 133-146.

Agostinho, S., Tindall-Ford,S.,Roodenrys, K (2013). "Adaptive diagrams: Handing control over to the learner to manage split-attention online." Computers & Education 64(2013): 52-62.

Bryant, S. M., Hunton, J.E. (2000). "The use of technology in the delivery of instruction: Implications for accounting educators and education researchers." Issues in Accounting Education 15(1): 129-162.

Chaffey, J., Van Peursem,K., Low,M. (2011). "Audit education for future professionals: Perceptions of New Zealand auditors." Accounting Education 20(2): 153-185.

Chandler, P., Sweller, J. (1991). "Cognitive load theory and the format of instruction." Cognition and Instruction 8(4): 293-332.

Chandler, P., Sweller, J. (1992). "The split-attention effect as a factor in the design of instruction". British Journal of Educational Psychology 62 (2): 233–246.

Chi, M. T. H., Bassock, M., Lewis, R., Reimann, P., & Glaser, R., (1989). "Self explanations: How students study and use examples in learning to solve problems." Cognitive Science 13: 145-182.

Chinnappan, M., Chandler P. (2010). "Managing cognitive load in the mathematics classroom." Australian Mathematics Teacher 66(1): 5-11.

Choi, F. D. S., Mueller, G.G., (1992). International accounting, Prentice-Hall.

Cloyd, B. C. (1997). "Performance in tax research tasks: The joint effects of knowledge and accountability." The Accounting Review 72(1): 111-113.

Fechner, H. E., Kilgore, A., (1994). "The influence of cultural factors on accounting practice." International Journal of Accounting. 29: 265-277.

Ginns, P., (2006). "Integrating information: a meta-analysis of the spatial contiguity and temporal contiguity effects. " Learning and Instruction. 16, 511–525.

Hussey, J., Hussey, R., (1997). Business research: A practical guide for undergraduate and postgraduate students. London, Macmillan.

Institute of Chartered Accountants of Zimbabwe (ICAZ), (2013). "ICAZ 'happy' with results." http://www.icaz.org.zw, Accessed, 30 March 2013.

Kalyaga, S. P., Chandler, P., Sweller, J (1999). "Managing split attention and redudancy in multimedia instruction " Applied Cognitive Pschology 13: 351-371.
Kalyaga, S. P., Chandler, P., Sweller, J (2001). "Learner experience and efficiency of instructional guidance." Educational Psychology 21(1): 5-23.
Kalyaga, S. P., Chandler, P.,Tuovinen, J., Sweller, J (2001). "When problem solving is superior to studying worked examples." Journal of Educational Psychology 93: 579-588.
Kariwo, M. T. (2007). "Widening access in higher education in Zimbabwe." Higher Education Policy 20: 45-59.
Kirschner, P. A., J. Sweller, and R. E. Clark. (2006). "Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching." Educational Psychologist 41 (2): 75–86.
Libby, R., Tan, H.T., (1994). "Modelling the determinants of audit expertise." Accounting Organisations and Society 19(8): 701-716.
Lovett, M., Greenhouse, J.B. (2000). "Applying cognitive theory to statistics instruction." The American Statistician 54(3): 196-206.
Mayer, R. E., Chandler, P., (2001). "When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? ." Journal of Educational Psychology 93: 390–397.
Mertens, D. M., Ed. (2005). Research and evaluation in education and psychology : integrating diversity with quantitative, qualitative, and mixed methods, Sage Publications.
Mostyn, G. R. (2012). "Cognitive load theory: What it is, Why its important for accounting instruction and research." Issues in Accounting Education 27(1): 227-245.
Mumbengegwi, S. C. (2001) "Zimbabwe: Quality education for all: Knowledge, technology and the future of higher education". Available online, http://www.ibe.unesco.org/International/ICE/ministers/Zimbabwe.pdf. Accessed 29 March 2013.
Owens, P., Sweller, J. (2008). "Cognitive load theory and music instruction." Educational Psychology 28: 29-45.
Paas, F., Renkel, A.,Sweller,J., (2004). "Cognitive load theory: Instructional implications of the interaction between information structures and cognitive architcture." Instructional Science 32: 1-8.
Peasnell, K. V. (1993). "Accounting in developing countries: A search for appropriate technologies." Research in Third World Accounting 2: 31-34.
Rezaee, Z., Elam, R., Cassidy, J.H., (2005). "Electronic commerce education: Insights from academics and practioners." Advances in Accounting 21: 233-258.
Roodenrys, K., Agostinho,S.,Roodenrys,S.Chandler, P. (2012). "Managing one's own cognitive load when evidence of split attention is present." Applied Cognitive Pschology 26: 878-886.
Sweller, J., Ayres, P.,L.,Kalyuga,S., (2011). Cognitive load theory, Springer.
Sweller, J., Chandler, P. (1994). "Why some material is difficult to learn." Cognition and Instruction 12(3): 185-233.
Sweller, J., Cooper, G.A. (1985). "The use of worked examples as a substitute for problem solving in learning algebra " Cognition and Instruction 2: 59-89.
Sweller, J., van Merrieboer, J.J.G., Paas, F.G.W.C. (1989). "Cognitive architecture and instructional design." Educational Psychology Review 10(3): 251-296.
Tarmizi, R., Sweller, J. (1988). "Guidance during mathematical problem solving." Journal of Educational Psychology 80: 424-436.
Tuovien, J. E., Sweller, J (1999). "A comparison of cognitive load associated with discovery learning and worked examples." Journal of Educational Psychology 91(2): 334-341.
Wallace, R. S. O. (1990). "Accounting in developing countries. Research in Third World accounting. ." Australian Journal of Management. 1(April).
Ward, M., Sweller, J. (1990). "Structuring effective worked examples." Cognition and Instruction 7(1): 1-39.