A WHOLE BRAIN® LEARNING APPROACH TO AN UNDERGRADUATE AUDITING INITIATIVE – AN EXPLORATORY STUDY

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Abstract

Purpose: Individual students have different learning styles, and lecturers can no longer afford to ignore this. Lecturers have a responsibility to accommodate students' different learning styles by including learning style flexibility in the offered learning opportunities. The objective of this study is to map a teaching case study against the Herrmann Whole Brain® Model to determine whether learning style flexibility were incorporated in the teaching case study.

Design/methodology/approach: A teaching case study was developed and delivered as part of an undergraduate level course at a South African residential university. The case study's primary intention was to illustrate the practical evaluation of general controls in an information technology environment. The teaching case study was analysed in terms of the Herrmann Whole Brain® Model in order to determine whether learning style flexibility had been accommodated in the learning opportunity.

Originality/value: This paper contributes to the literature in accounting education by focusing on learning style flexibility specifically using Herrmann's Whole Brain® Model, as it appears that limited examples of the use of this model in accounting education have yet been published. While this paper discusses the use of an auditing case study, the results may be of interest to lecturers in other subject areas across the academic spectrum.

Findings: Based on an analysis of the teaching case study against the Herrmann's Whole Brain® Model, it is evident that the teaching case study incorporated activities addressing all four quadrants of the whole brain model. It can therefore be concluded that the learning opportunity incorporated learning style flexibility.

Keywords: Accounting education, whole brain learning, learning style flexibility, Herrmann Whole Brain® Model

Introduction

Is incorporating learning style flexibility in accounting education a “mission impossible”? The objective of this study was to determine whether learning style flexibility were accommodated in accounting education by means of a teaching case study. This was done by mapping a teaching case study, a widely recognised strategy in the teaching environment (Killen, 2010; Constance, Bowe, Voss and Aretz, 2009; Kim, Phillips, Pinsky, Brock, Phillips and Keary, 2006) against the Herrmann Whole Brain® Model.

In the teaching environment the missing link in students’ learning process was found to be the lecturers’ perceptions of the environment (Felder and Brent, 2005; Trigwell, Prosser and Waterhouse, 1999). During the teaching process, lecturers should thus remember that there is a variety of methods and strategies that students use to learn, acquire and retain new information (De Boer, du Toit, Scheepers and Bothma, 2013; Felder and Brent, 2005; Prensky, 2001). Lecturers should also keep in mind that individual students use different methods and strategies to learn, and that these are influenced by the individual’s learning style preferences and competencies, which, for convenience in this paper, will be referred to as a student’s learning style (De Boer *et al.,* 2013; Margaryan, Littlejohn and Vojt, 2011; Prensky, 2001; Oosthuizen, 2001). Lecturers can no longer ignore the fact that different students interact differently when confronting new information and acquiring new skills (De Boer *et al.,* 2013; Margaryan *et al.*, 2011; Oosthuizen, 2001). Taking into account the advantages of accommodating students’ different learning styles (Tshuma, 2012) it is evident that lecturers should take this diversity into account while preparing for and during lecturing and should aim to incorporate learning style flexibility during the creation of learning opportunities, through the use of learning style models.[1]

In an independent research report on multiple learning styles models, conducted by Coffield, Moseley, Hall and Ecclestone in 2004, a wide range of learning style models and instruments were investigated. The report identified six promising instruments, which were considered worthy of further research (Coffield *et al.*, 2004). One of these instruments was the Herrmann’s Brain Dominance® Instrument (HBDI). The HBDI describes the human brain as a four quadrant model of which each quadrant have different thinking and learning

[1] Herrmann International. Not dated. *Overview of the HBDI.* [Online] available from: http://www.hbdi.com/WholeBrainProductsAndServices/thehbdi.php [Accessed: 2013/09/29].

styles (Van Oordt, van Oordt and du Toit, 2014). Individuals have dominant preferred thinking and learning styles preferences that are highlighted in the Herrmann Whole Brain® Model (Van Oordt *et al.,* 2014; De Boer *et al.,* 2013). It provides a tool that enables lecturers to enhance learning style flexibility by accommodating students' diverse thinking preferences, and it also develops the students' less preferred modes of learning (Van Oordt *et al.*, 2014, De Boer *et al.,* 2013) and was therefore selected as the framework for measuring whether learning style flexibility was accommodated by means of the teaching case study.

Previous research on the Herrmann's Whole Brain® Model include research on the implementation of a Whole Brain® instructional approach at a number of high schools in Taiwan, which reported positive feedback on students' learning attitudes as well as their learning retention (Lee, 2005). On tertiary level studies using Herrmann's Whole Brain® Model indicated that the enhancement of the quality of lecturers' facilitation of learning practices are influenced by the lecturers' awareness of their own thinking preferences and the implication thereof on their practices (De Boer, Bothma and du Toit, 2011; De Boer, Steyn and du Toit, 2001). Engineering students' diverse thinking style preferences were measured and a diversity of thinking style preferences amongst the individual engineering students in the group were reported (Horak, Steyn and de Boer, 2001). As part of a business management course various interventions and activities, addressing the different learning preferences, were investigated (Le Roux, 2011). The possibility of team teaching as an effective collaborative approach to accommodate students' diverse learning preferences was investigated in the field of taxation (Van Oordt *et al.*, 2014). Research into the use of the Herrmann's Whole Brain® Model in accounting education, and specifically the implementation thereof in auditing, is limited which lead to the following research question: Can a teaching case study accommodate learning style flexibility, when measured against Herrmann's Whole Brain® Model? A teaching case study, which is an inquiry in which the researcher(s) develop an in-depth analysis of a case in its real world context (Yin, 2014), was developed and implemented at a South African residential university during the facilitation of learning of general controls in an information technology environment.

This paper contributes towards the literature regarding learning style flexibility in accounting education. It introduces accounting educators to the Herrmann Whole Brain® Model by providing an example of how learning style flexibility can be incorporated into

accounting education, particularly by means of teaching case studies. It may therefore be of interest to other accounting educators across the globe. Although students' learning experience might have improved due to the incorporation of learning style flexibility, this was not the focus of the study.

This paper is structured as follows. Firstly, literature that supports the use of learning style flexibility in education is discussed. This includes identifying the different preferences, student expectations, and ways of facilitating learning in terms of Herrmann's Whole Brain® Model. Detailed information about the teaching case study, and the manner in which it was implemented, is then presented followed by the research method. The paper concludes with an analysis of the teaching case study against the Herrmann's Whole Brain® Model framework, to determine whether learning style flexibility was accommodated by means of the teaching case study.

Literature review

Learning styles

The South African Concise Oxford Dictionary (2005) defines learning as "knowledge or skills acquired through experience or study or by being taught". Each student acquires skills or knowledge in a different manner, based on the way they prefer to learn representing their learning preferences (De Boer *et al.,* 2013; Felder and Brent, 2005; Prensky, 2001). Learning preferences can differ depending on circumstances (De Boer *et al.,* 2013; Felder and Brent, 2005; Prensky, 2001) and are not fixed as it can change over time (Ugur, Akkoyunlu and Kurbanoglu, 2011). These different learning preferences are also referred to as learning styles (Richardson, 2011). Components of learning styles were included in research literature as early as 1892 but the term "learning style" was first used in 1954 (Fatt, 2000). A learning style can thus be defined as "a consistent pattern of behaviour that a learner uses to approach and master learning content" (Coetzee, van Niekerk and Wydeman, 2008). Learning styles should be taken into account during the teaching process to cater for all the students' different learning styles, thus accommodating learning style flexibility (Lucas, Dippenaar and du Toit, 2014; Du Toit, 2012; Ngozo, 2012; Tshuma, 2012; Cekiso, 2011; McChlery and Visser, 2009; Coffield *et al.*, 2004). The incorporation of learning style flexibility in learning opportunities will lead to students feeling more comfortable in the learning process as their individual styles are catered for (Lucas *et al.*, 2014; Cekiso, 2011). This will enhance student participation and increase academic success (Cekiso, 2011). An additional benefit is that students will learn

to adapt to the learning opportunities presented to them, even it is not in their preferred learning style, thereby developing their less preferred learning styles (Lucas *et al.*, 2014; Ngozo, 2012; Cekiso, 2011).

Learning style flexibility has been the topic of educational research (Coffield *et al.*, 2004) and studies determined that various outside factors such as culture plays a role in students' preferred learning styles (Joy and Kolb, 2009). This emphasises the importance of learning style flexibility as the Higher Education environment are faced with globalisation (Sugahara and Boland, 2010). The accounting education in Higher Education are no different and learning style flexibility should form part of it (Van Oordt *et al.,* 2014; Wattey, Jackson and Yu, 2010; Sugahara and Boland, 2010; Visser, McChlery and Vreken, 2006; Duff, 2004; Duff, 2001).

Research into learning style flexibility in accounting education has focused primarily on the different methods and instruments used (Bandura and Lwons, 2012; Fortin and Legault, 2010; Wattey *et al.*, 2010; Duff, 2001), on the the role of cognitive learning styles in developing learning competencies (Apple *et al.*, 2012; Duff, 2004) and on the differences between learning styles and culture (Abhayawansa and Fonseca, 2010; Sugahara and Boland, 2010; McChlery and Visser, 2009). Students' learning styles and their instructors' teaching styles in accounting courses were compared, concluding that there were little difference between the instructors' teaching styles and the students' learning styles (Visser *et al.*, 2006).

Learning style models

There are many different learning style models and ways in which lecturers can accommodate learning style flexibility during learning opportunities. An extensive study was performed by Coffield *et al.* in 2004, examining multiple learning style models, with the primary aim of contributing to the understanding of the different learning style models. A secondary aim of the study was to identify those areas worthy of further research. In this study, learning styles were classified into five groups according to claims about each model's flexibility and modifiability (Coffield *et al.*, 2004). These classifications ranged from the fixed, largely constitutionally based (thus "rather work with what you got than try and change it") learning styles at one extreme, ending at the other extreme, with those that acknowledged personal and other factors as part of a student's learning style (Coffield *et al.*, 2004). Kolb's learning style inventory, which has predominantly been used in

accounting literature (Sugahara and Boland, 2010) together with Herrmann's Whole Brain® Model, which supports Kolb's Model of learning styles (Ngozo, 2012) was included in the group of learning styles with flexibly stable preferences (Coffield *et al.*, 2004). This group highlights change and development (Hall and Moseley, 2005), and share a leaning towards the belief that personal factors (such as motivation), and environmental factors (such as co-operative or individual learning), do play a part in students' learning styles (Coffield *et al.*, 2004). The research indicated that Herrmann's Whole Brain® Model was a good way of reflecting on thinking and learning preferences, at both individual and group level (Coffield *et al.*, 2004). The investigation showed that some of the instruments had serious weaknesses, and concluded that the investigated models had vast differences, and were "not of equal worth". Furthermore, it was found that the reasons for choosing a specific instrument were of upmost importance (Coffield *et al.*, 2004). The overall assessment reached by Coffield *et al.* (2004) indicated that Herrmann's Whole Brain® Model "offers considerable promise for use in education and training", that it was based on sound values, and that it encouraged flexibility, adaption and change (Coffield *et al.*, 2004).

Herrmann's Whole Brain® Model

The Herrmann Whole Brain® Model had its origin in 1976. Ned Herrmann, while doing research on the brain as a source of creativity, came across the then ground-breaking research of Roger Sperry, Paul MacLean, Joseph Bogen and Michael Gazzanaga. They had been researching the brain since the 1950s, and their research clearly indicated that the brain has four distinct and uniquely expert structures. Sperry's research revealed that the left and the right sides of the brain perform different tasks, while MacLean's research indicated that the cerebral system, limbic system and the brain stem are each responsible for different types of thinking, such as reason, emotion and autonomic functions. Inspired by this research, Herrmann did further research and identified four distinct types of thinking, each roughly corresponding to one of the brain structures, which resulted in the formulation of the Herrmann Whole Brain® model.[2] Herrmann initially accepted the idea of dominant brain quadrants as a neurophysiological fact, but concluded in later years that it was more useful as a metaphorical tool (De Boer *et al.,* 2013; Hall and Moseley, 2005).

[2] Herrmann International. Not dated. *Whole brain learning unlocks students' potential.* [Online] available from: http://www.hbdi.com/SolutionsFor/education.php [Accessed: 2013/09/29].

According to Herrmann's Whole Brain® Model, its four quadrants represent the brain's four thinking structures, and each quadrant has very distinct clusters of cognitive functions (De Boer *et al.*, 2013; De Boer *et al.*, 2001). In order to determine an individual's preferred quadrant(s) of thinking, the Herrmann Brain Dominance Instrument® (HBDI) is used (De Boer *et al.*, 2013). The HBDI, which is a validated research instrument, consists of 120 items, that enable one to classify an individual's dominant thinking styles (also sometimes referred to as learning styles) (De Boer *et al.*, 2013; Coffield *et al.*, 2004) and which are labelled in terms of the dominant quadrants of the brain. The four quadrants of the brain are visually presented in Figure 1:

Figure 1: The whole brain model

A quadrant (upper left)	**D quadrant (upper right)**
- Logical - Analytical - Fact-based - Quantitative	- Holistic - Intuitive - Integrating - Synthesising
B quadrant (lower left)	**C quadrant (lower right)**
- Organised - Sequential - Planned - Detailed	- Interpersonal - Feeling-based - Kinesthetic - Emotional

(Herrmann, 1996)

Quadrant A: (also referred to as the blue quadrant and represented by cerulean blue (resembling "the color of the cloudless sky" – South African Concise Oxford Dictionary (2005)) represents cerebral processing: thinking and learning is analytical and logical; deals with analysis of facts and processing of numbers.

Quadrant B: (also referred to as the green quadrant as green suggested groundedness) represents thinking and learning that is organised and detailed; deals with planning approaches and organising facts.

Quadrant C: (also referred to as the red quadrant, representing the emotional and passionate approaches) represents thinking and learning that is personalised, interpersonal, expressive and feeling based.

Quadrant D: (also referred to as the yellow quadrant with yellow representing the quadrant's imaginative and vibrant nature) represents thinking and learning that is visual, imaginative, holistic and conceptual, and is future-orientated.

Most people do not have a strong preference for only one quadrant (Coffield *et al.*, 2004; Herrmann, 1996). The most frequently identified pattern shows that 60% of all tested participants have strong preferences for (or abilities based in) two quadrants, whilst 30% of tested participants have strong preferences for (or abilities based in) three quadrants (Herrmann, 1996). Herrmann stated that "the world is a composite whole brain" and that, provided the sample size is sufficiently large (at least 100 people), the sum of the individual profiles will provide a highly diverse, but well balanced spread, across the four quadrants of the brain (De Boer *et al.*, 2013).

The impact of Herrmann's Whole Brain® Model on teaching

The students' preferences for a specific quadrant therefore represents a specific set of preferences that guides their learning approaches, and their expectations of what learning should entail (De Boer *et al.*, 2013). From the lecturer's point of view, this has a direct impact on the way content is taught, as each quadrant of the brain requires a different approach to effective teaching or facilitation of learning – the new term used in education (De Boer *et al.*, 2013; De Boer *et al.,* 2001). Appendix A presents the preferences, expectations and ways of facilitating learning for students exhibiting each of the four quadrants' specific thinking preferences (De Boer *et al.*, 2013).

By incorporating learning style flexibility in lecture preparation, and by involving the whole brain in learning, more effective learning takes place as students' preferred thinking styles are accommodated. In addition, the students' less-dominant learning styles will also be developed (De Boer *et al.*, 2013; Knowles, Buzan, Jensen, Ornstein cited in De Boer *et al.*, 2001). Another advantage of this approach is that it is inclusive by nature, and will promote participation by all students, regardless of learning style preference (Tshuma, 2012).

Numerous examples of whole brain initiatives in higher education in a range of disciplines such as health sciences, engineering and information management were successfully incorporated in the curriculum development, learning opportunities and assessment of the various courses (De Boer, du Toit and Bothma, 2015; De Boer *et al.,* 2011; Horak *et al.*,

2001). Engineering and criminology students' diverse thinking style preferences were measured and a diversity of thinking style preferences amongst the individual students in the groups were reported (De Boer and van den Berg, 2001; Horak *et al.*, 2001) which correlates with Herrmann's statement that the "the world is a composite whole brain" (De Boer *et al.*, 2013). This statement was also confirmed by a study in which educators thinking preferences were determined (De Boer *et* al., 2001). A Biochemistry and a Zoology module's assessments were analysed in order to determine if students perform better in questions that involve more than one learning style. The questions in the assessment were classified according to Herrmann's Whole Brain Model and the findings revealed that students obtained similar marks in questions accommodating the different brain quadrants. This could be because of other factors such as the relevance of the assessments and whether the assessments were aligned with the modules' outcomes (Lucas *et al.*, 2014). In a study conducted in Jordan in which the effect of Herrmann's Whole Brain Model on the understanding of electric circuits were investigated, it was reported that learning opportunities using whole brain teaching were significantly more effective than learning opportunities involving traditional teaching methods (Bawaneh, Zain and Saleh, 2011) confirming that more effective learning takes place when students' preferred thinking styles are accommodated (De Boer *et al*, 2013).

The possibility of team teaching as an effective collaborative teaching approach by two selected lecturers, who's thinking profiles represented a fairly whole brain profile, was investigated in the field of taxation (Van Oordt *et al.*, 2014). The results indicated that the collaborative lecture had a higher energy level than other lectures in the same series and suggested that the students had a better understanding of the content covered in the collaborative lecture (Van Oordt *et al.*, 2014). This substantiates the claim that more effective learning takes place when students' preferred thinking styles are accommodated (De Boer *et al*, 2013) although some students found the switching of lecturers distracting (Van Oordt *et al.*, 2014). As part of a business management course various teaching interventions and activities, such as the presentation of factual information, bullet point slides representing detailed instructions, mindmaps, group work and case studies, addressing different learning preferences, were implemented. These interventions and activities were classified according the four quadrants of Herrmann's Whole Brain Model as the dominance of thinking preferences for each of the interventions could clearly be identified, and it was concluded that the interventions supported different thinking preferences (Le Roux, 2011).

The teaching case study that follows was developed based on the literature contained above.

Case narrative

The purpose of the teaching case study was to incorporate learning style flexibility to address the diverse thinking preferences of students. The academic content of the case study dealt with the general controls that should be present in an information technology environment, the details of which were presented during two lectures, as is discussed below.

Lecture 1

The first lecture was 80 minutes long, and was presented following a teacher-centred approach. This lecturer started off by recapping the basic principles of internal control (dealt with during a previous lecture). This was followed by a presentation that addressed the background to information technology systems, the different information technology environments, and the computerised internal controls that should be present in a business environment. The final phase of the lecture was spent discussing the effect of these elements on the audit process. Students were then instructed to divide themselves into groups of eight (there are eight categories of general controls described in the students' prescribed textbook), and number the group members accordingly. Assignment 1 (reproduced next), was then provided to the students.

Assignment 1:

1. Each one of you needs to study the general control indicated by the number assigned to you by your group and prepare an internal control questionnaire for that specific general control. These internal control questionnaires will be used during the next lecture to assess a client's general controls.
2. Each group needs to prepare a schematic representation of the different categories of general controls and the interaction between general controls and application controls on an A3-size poster. The due date will be given to you during the next lecture.

Lecture 2

The second lecture was presented seven days after the first lecture. Before the start of this (extended) 2 hour lecture posters were placed on the doors to the lecture hall, welcoming

the students to *"The Company Limited"* (a simulated company). *"The Company Limited's Chief Information Officer's office*" (real-life situation) was simulated in the lecture hall using *inter alia* a laptop computer, server, network cable, printer, uninterrupted power supply, backup tapes and compact discs, powder based fire extinguisher, pens, telephone, book marked *"Disaster recovery plan"*, etc. As the students walked into the lecture hall an e-mail, containing assignment 2, was handed to each of them by an academic assistant.

Assignment 2

You are a trainee accountant at UP Incorporated, a firm of registered auditors. Upon arriving at the office this morning you received the following e-mail from Mrs Lecturer, one of the directors at the audit firm.

The Company Limited – assessment of general controls

From: lecturer@upinc.co.za

To: trainee.accountant@upinc.co.za

Date: 2nd lecture date, 07:35

Subject: The Company Limited – assessment of general controls

Dear Trainee Accountant,

You and the rest of your audit team are urgently requested to go to The Company Limited. This company is one of our firm's new audit clients and we need to assess the company's general controls.

I need a report, detailing your audit team's findings, in two weeks' time to enable me to continue with the planning of the company's audit. Assignment 1's information must also be attached to the report.

Regards

Mrs Lecturer
Director – UP Incorporated

After the students were seated, the lecturer introduced herself as the Chief Information Officer (CIO) of the Company Limited, and shared with the students (trainee auditors)

information regarding weaknesses and strengths in the general controls in the company's information technology environment. (Detail regarding the information shared during the simulation is contained in Appendix B). The students were then allowed the opportunity to ask the lecturer (in the roll of CIO) questions regarding the company's general controls, based on the internal controls questionnaire that they had prepared for the lecture.

After the simulation, the students were given the opportunity to discuss their findings (which were used in the final reports) in their groups (consisting of eight students). During this time, the lecturer moved around between the groups listening to their discussions, asking questions and providing guidance where necessary.

On completion of this discussion period, the lecturer asked two members from each group to join another group and to discuss their group's findings with their new group; thereafter the group members returned to their original groups. The group members then shared what they learned from the other groups with their original group members.

The report, detailing each group's findings regarding *The Company Limited*'s general information technology environment, had to be submitted two weeks after the second lecture. The groups also had to include in their reports the internal control questionnaires that they had prepared for and used in lecture two, as well as the schematic representation of the different categories of general controls, and the interaction between general controls and application controls. These three assignments were assessed and marks were awarded based on whether all three assignments had been completed, and additionally on the format of the internal control questionnaires, the layout of the report, and whether the poster addressed both the general controls and the interaction between general controls and application controls. The marks awarded for the assignments contributed to the students' year marks.

Research method

The research method consisted of a literature review and an analysis of a specific real world event, namely a teaching case study, which is especially useful for testing whether theoretical theories and models actually work in real world situations, against a theoretical model, namely the Herrmann Whole Brain® Model (Yin, 2014). This theoretical model was identified through the literature review as a theoretical theory for learning style flexibility.

Ethical clearance had been obtained before the development and implementation of the teaching case study.

Data collection

In order to determine whether the preferred ways of facilitating learning for students with thinking preferences described in each of the four quadrants, and thus learning style flexibility, were incorporated into the lecturing of auditing, documentation as a source of evidence were collected. The documentation contained the different ways in which learning were facilitated during the teaching case study lectures and consisted of the teaching case study itself as well as the lecturer's preparation notes for the teaching case study lectures.

The researchers, as the lecturers responsible for the course, individually coded the teaching case study and the preparation notes according to the different ways in which learning were facilitated during the teaching case study. This coding was based on their academic and professional backgrounds, and their understanding and knowledge of the specific components this educational context required. In order to ensure intercoder reliability the researchers compared their individually assigned codes for the teaching case study and the preparation notes. The codes which differed were discussed where after a conclusion were reached between the researchers on the different ways in which learning were facilitated during the teaching case study (Creswell, 2014; Lombard, Snyder-Duch and Bracken, 2004).

Data analysis

The agreed-upon ways in which learning were facilitated during the teaching case study was mapped against the ways of facilitating learning that are most effective for students exhibiting each of the four quadrants' specific thinking preferences contained in Appendix A. Pattern-matching logic, one of the most desirable in case study analysis (Yin, 2014), were used to analyse the data and interpret the findings. As each quadrant of the brain requires a different approach to effective teaching (De Boer *et al.*, 2013; De Boer *et al.,* 2001), learning style flexibility would have been incorporated into auditing lectures if the mapped ways of facilitating learning moved back and forth incorporating all four quadrants of the whole brain model (Horak *et al.,* 2001). This represents the predicted pattern to which the empirically based pattern, namely the teaching case study, were

compared to in order to determine if learning style flexibility were successfully incorporated into auditing lectures.

Analysis and description of data

The teaching case study was mapped against the Herrmann Whole Brain® Model, using the framework for identifying ways of facilitating learning for students with thinking preferences in each of the four quadrants (as was discussed in the literature review, and graphically presented in Appendix A).

The analysis is summarised in Table 1, and indicates the components of lecture 1, lecture 2 and the three assignments that correlated with the preferred ways of facilitating learning for students with thinking preferences described in each of the four quadrants.

Table 1: Analysis of the teaching case study using the Herrmann Whole Brain® Model

Teaching case	A quadrant	B quadrant	C quadrant	D quadrant
Lecture 1	Teacher-centred approach = fact-based lectures	Revision, background information, etc = checklists, timelines Clear instructions = checklists, timelines and structured problem solving with steps	Dividing of students into groups = small group and team learning	Effect on the audit process = holistic exercises, synthesis
Lecture 2	Simulation of real-	Simulation of real-		Simulation of real-

	life environment = case studies Asking of questions = applied logic	life environment = learning "'laboratories" (practice) Clear instructions = checklists, timelines	Asking of questions = learning "'laboratories" (interacting) Group discussions = small group, team learning and cooperative learning Rotation of group members = physical/ kinesthetic activities, listening and sharing ideas, cooperative learning	life environment = simulations Rotation of group members = brainstorming
Assignments	Internal control questionnaire = reference books, reading Report = analytical and critical thinking	Internal control questionnaire = sequential and self-paced learning Report = policies, procedures, organisation, summaries	Schematic representation = co-operative learning and group discussions Report = small group and team learning	Schematic representation = holistic exercises, synthesis and painting, drawing, design

Explanation of the analysis

With regard to the **first lecture**, a teacher-centred approach was followed and the content discussed during this lecture was based on concrete information that would typically accommodate the expectations of A quadrant students. B quadrant students' expectations were met by the revision of the basic principles of internal control previously dealt with. Their preferences for order and structure were additionally catered for by the provision of the background to information technology systems, the different information technology environments and computerised internal controls, as this outlined and provided a framework for the topic dealt with during the lectures. The discussion of the different information technology systems, environments and computerised internal controls and their effects on the audit process presented a "big picture" overview of the topic, thus fulfilling the expectations of the D quadrant students. At the end of this first lecture clear instructions were provided in anticipation of the next lecture, presenting the *how*, *what*, *why*, *where* and *when* aspects of the process. This created the opportunity for structured problem solving, thus addressing the expectations of the B quadrant students. By dividing the students into small work groups, this addressed the expectations of C quadrant students.

During the **second lecture**, which focused specifically on general controls in an information technology environment, learning was facilitated by means of a case study, presented as a real-life simulation. A combination of experiential learning (to present students with the challenges of a real-life situation during the lecture), group work and discussions were used. The teaching case study therefore met the learning preferences of the A quadrant students, while the real-life simulation was a feeling-based, hands-on simulation which met the expectations of the D quadrant students. It also created a learning environment in which the students could practice their skills, which accommodated the preferences of B quadrant students. The asking of questions as they related to discovery learning, was aimed at the D quadrant students' expectations, and it also created an opportunity for the A quadrant students to apply logic when asking their questions. The instructions contained in the e-mail provided the *how*, *what*, *why*, *where* and *when* - addressing the expectations of the B quadrant students. The opportunity to ask questions of the CIO, the group discussions, and the rotation of the group members all addressed the expectations of the C quadrant students. The opportunity to ask questions provided the C quadrant students with an interactive learning "laboratory"; the group discussions created an opportunity for small group and team learning and learning from

one another (cooperative learning). The rotation of the group members kept the momentum of the lecture going and allowed for a physical activity. It also allowed the students to brainstorm and share their ideas with one another, which is typically a way of facilitating learning for the preferences of D quadrant students.

In order to complete the internal control **questionnaire** each student had to consult their text books as well as other external sources (for example the internet), in order to investigate a specific general control in the information technology environment. In addition, they had to obtain information regarding internal control questionnaires, such as what should be included in an internal control questionnaire, the preferred format, etc. This assignment therefore met the expectations of the A quadrant students (the research references and textbook readings), as well as the expectation of the B quadrant students (they could pace their own learning). The **poster** containing the schematic representation of the different categories of general controls and the interaction between general controls and application controls fulfilled the expectations of the D quadrant students. It provided them with a holistic view of the theoretical content and it also gave them an opportunity to experiment and be creative, as there was no fixed or prescribed format for the poster design. The poster assignment was also a group project, allowing the students to learn from their fellow group members (cooperative learning) and through group discussions, which is the preferred learning mode for C quadrant students. By **working** together **as a group** while preparing the report, interactive learning was effected, which typically fits into the C quadrant mode of learning. The **writing of the report** fulfilled the expectations of students with B quadrant thinking preferences as these students normally prefer organised, methodical types of activities, and following clear policies and/or procedures. Students with A quadrant preferences were also accommodated, as the report required analytical and critical thinking to evaluate the company's general controls.

Learning style flexibility would have been in the teaching case study if the mapped case study incorporated all four quadrants of the whole brain model (Horak *et al.,* 2001), thus matching the predicted pattern (Yin, 2014). As reflected in Table 1 the teaching case study components incorporated all four quadrants of the whole brain model and therefore reflected the pattern-matching logic of whole brain learning (Yin, 2014; Horak *et al.,* 2001). By classifying the teaching case study's components it was indicated that the teaching case study utilised a variety of teaching methods and strategies, such as *inter alia* the presentation of factual information, detailed instructions, a holistic poster, group work as

well as the teaching case study itself. The components could all be clearly identified and supported different thinking preferences, representing whole brain learning (De Boer *et al.,* 2013; Le Roux, 2011). Based on the analysis of the teaching case study and the classification of its components it can therefore be concluded that a teaching case study can accommodate learning style flexibility, when measured against Herrmann's Whole Brain® Model.

Conclusion

The objective of this study was to map a teaching case study against the Herrmann Whole Brain® Model to determine whether learning style flexibility were incorporated in a teaching case study. In order to facilitate more effective learning it is important for lecturers to create learning opportunities that cater for the different learning styles of the students attending their lectures. Understanding the different learning styles of students may assist lecturers in designing differentiated case studies to accommodate all learning styles across a diverse student group. One way of creating these flexible learning style opportunities is to address the preferences and expectations of students as identified in the four quadrants described in Herrmann's Whole Brain® Model.

Herrmann's Whole Brain® Model was used to analyse the teaching case study as it is a well-known and recognised model that provides a tool that enables lecturers to enhance learning style flexibility by accommodating students' diverse thinking preferences. The researchers, as the lecturers responsible for the course, individually coded the teaching case study and the preparation notes according to the different ways in which learning were facilitated during the teaching case study. It was evident from the analysis that the teaching case study incorporated activities that addressed all four quadrants of the whole brain model and thus matched the predicted pattern for learning style flexibility. It can therefore be concluded that the incorporation of learning style flexibility in accounting education is a "mission accomplished".

Due to the nature of the study namely being a teaching case study the inherent limitations are that it was conducted in a single topic within the field of auditing and that the students' actual achievements (assignment grading) and perceptions on whether or not learning style flexibility had added to their learning experience were not tested. The conclusion reached is also that of the researchers, drawn from their beliefs and based on their

teaching experience, and not from independently obtained and exhaustively analysed empirical data. This paper contributes to the literature regarding learning style flexibility in accounting education. It introduces accounting educators to the Herrmann Whole Brain® Model by providing an example of how learning style flexibility can be incorporated into accounting education, particularly by developing and implementing teaching case studies. Avenues for further research include the development and analysis of other teaching case studies, and as importantly, obtaining students' feedback regarding their learning experiences arising from the completed case studies.

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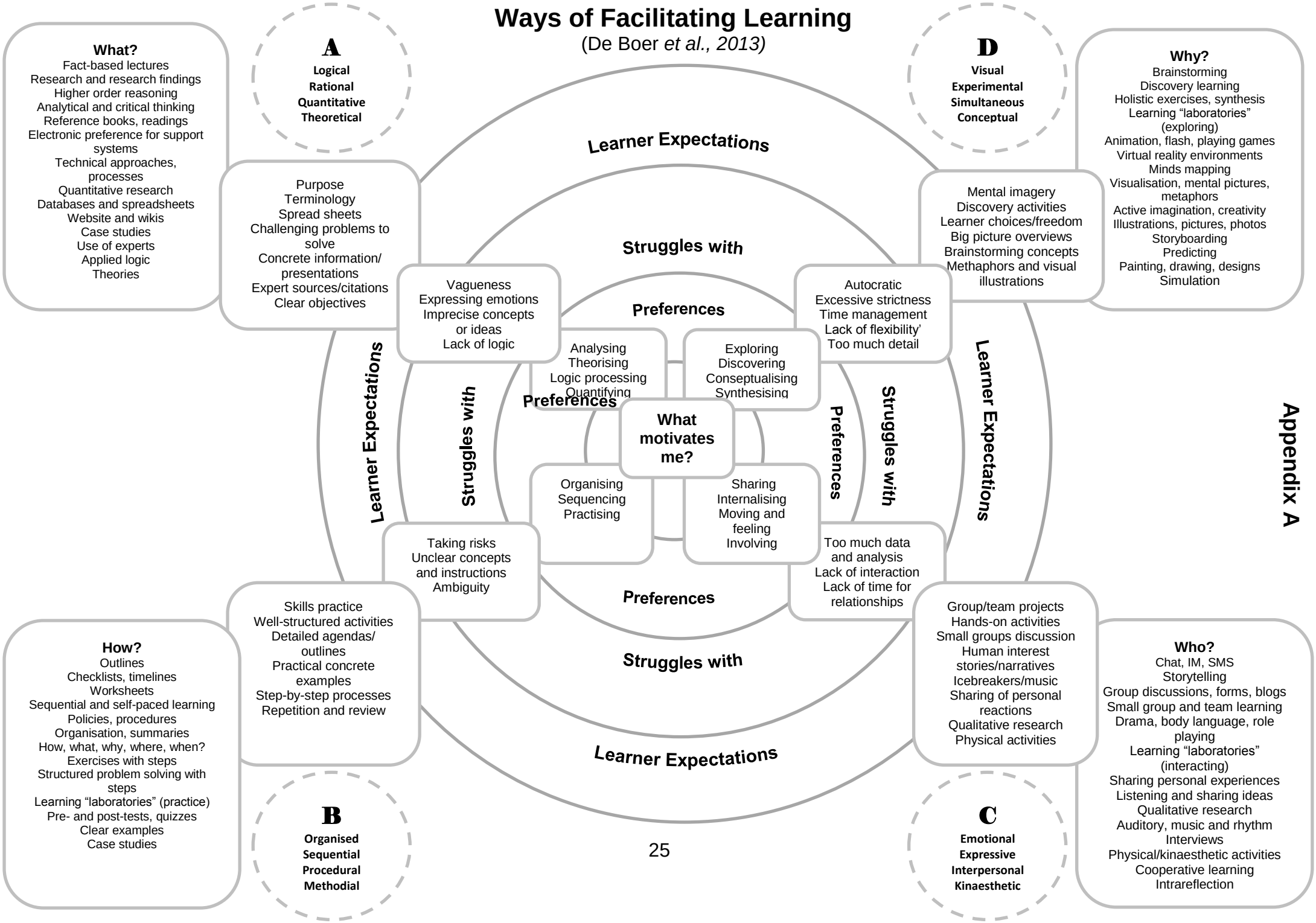
(De Boer *et al., 2013)*



Appendix B

Detail regarding information shared during simulation [lecturer's script]

Walk into class with laptop and mug of coffee, drinking as I go along.

Welcome at The Company Limited. Sorry I'm a bit late - traffic was hectic, but luckily you did not had to wait outside my office. I am mrs Gail Bates, the Chief Information Officer of The Company Limited. Mrs Lecturer said that you would come around this morning to assess our company's general controls.

I don't know what you want to start with but maybe it is a good idea to have a look at our IT department's structure first. Just give me a second to set up my laptop; the information is stored on the server. If my laptop goes off don't worry it is only the plug here at the back not making proper contact.

Set up laptop, with no password and not locked to the desk. Open Powerpoint slide containing the structure of the IT department.

This is our IT department's structure; we function completely separate from the user departments. All the people working in my department are competent and experienced IT personnel.

We have a software manager and an infrastructure manager. The software manager oversees the webmaster and the application development and programming division. The webmaster is responsible for all the functions relevant to our company's website, which is a crucial part of our business because as you can see we also offer an online sales service and our application development and programming division consists of systems analysts and the programmers.

The infrastructure manager is responsible for the databases, operating system and the network as well as the help desk with its operators where users log their problems and requests and security. Unfortunately this position is vacant at the moment as our security officer joined Sahara.com. Hopefully this position will soon be filled as I asked the other personnel in the IT department to get one of their friends to join our company.

With that out of the way, let me show you around. Each of us here at IT4-4 Limited has a laptop computer, all of these laptops are linked to our company's local area network, to the server and then to the internet. Show server. *All of us also make use of this network printer, so don't worry if you see strange people walking into my office – it is most probably just one of the personnel collecting printouts.*

If you'll excuse me but while we are busy talking I just need to quickly install the updates for the inventory programme which I downloaded from the internet last night. Look for memory stick in laptop case. *Where's that memory stick? Not to worry, luckily I've saved it on this one as well, and while we're busy don't you have some nice games on your computer which I can copy? I've got a few nice ones on this memory stick if you want it.*

Anything else you would like to know? Well then this is done, I quickly need to go and buy a reporting package for the database. The project and the chosen software package was approved from all the relevant people, and as you all know packaged software comes with user manuals, so if you can read you can report. No need for training here!

Enjoy the rest of your day.