CHAPTER 3

3. LEARNING FACILITATION VIA THE WHOLE BRAIN TEACHING AND LEARNING MODEL

3.1 The Whole Brain Teaching and Learning Model

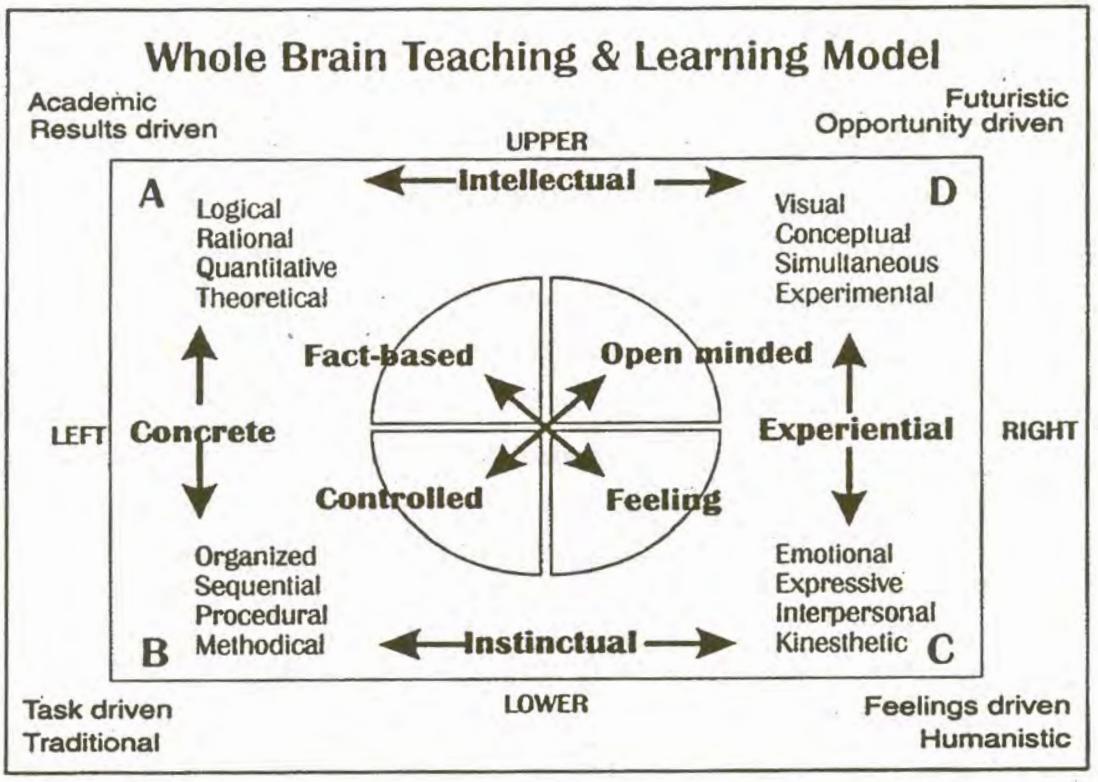
3.1.1 Introduction

Whole brain technology is a concept that is easy to use, valid and reliable, supplying a quantified measurement of individual learner's thinking style preference. According to the research by Herrmann (1996:151) a group consisting of eighteen or more learners will represent a diverse spectrum of thinking style preferences thus, representing a composite whole brain group. Herrmann designed a "Teaching and Learning Model" (Figure 15, p. 79) based on the whole brain concept. This model assists facilitators of learning in accommodating and developing diverse thinking styles and in making learning more meaningful for all learners. It describes the conditions under which learners with strong preferences in the four different quadrants learn best.

Learners with strong thinking style preferences for the A-quadrant prefer a cognitive and rational approach. When in this mode the learner is likely to approach problem solving in a logical manner and to take account of facts, figures, statistics and other tangibles. The learner will prefer conclusions that are backed up by supporting data or by examples of precedent. Learners expect the facilitator to reduce the complex content to the simple, the unclear to the clear and the cumbersome to the efficient. This mode prefers structure in a practical and procedural sense (Herrmann International, 1999:6)

Learners with strong preferences in the B-quadrant have a natural inclination towards organization, reliability, efficiency, order and discipline. Tasks might frequently be prioritized and tackled in a systematic and sequential manner. This quadrant is methodical and attentive to detail (Herrmann International, 1999:6).

Figure 15: Whole Brain Teaching and Learning Model



(Herrmann, 1996:155; 1995:417)

Learners with strong thinking style preferences for the C-quadrant are naturally in tune with and sensitive to others' needs, attitudes and atmosphere. There is usually an attraction to people plus an ability to relate to others and express themselves easily. Characteristics may include good interpersonal skills with an awareness of the feelings of others and ease of communication (Herrmann, 1999:7).

With a D-quadrant preference the learner can usually handle several mental inputs simultaneously, make rapid connections and feel comfortable with abstract concepts. An initially holistic approach to problem solving may be preferred and conclusions are reached in a spontaneous rather than a studied manner. Lateral thinking takes place in this mode and inspires imaginative, innovative and original

ideas. According to Herrmann this quadrant could be described as the catalyst for the creative process. Learners may have an inclination towards adventure, experimenting and risk taking (Herrmann, 1999:7).

3.1.2 Facilitation of learning in the study unit of Toothmorphology via the Whole Brain Teaching and Learning Model

Traditionally the content in the study unit of Toothmorphology is delivered using the lecture-based method of instruction in a series of lectures during the third year of study in dentistry. The lecturers deliver the content (knowledge) of Toothmorphology via formal lectures to the learners who have to sit and listen passively, take notes and learn (memorize) the content in order to pass tests and examinations (summative assessment). There are however, opportunities for learners to make drawings of the content to represent the work visually. Sometimes relevant content is presented by using video material or a slide show to make learning more stimulating and visual. This kind of teaching practice gives the impression that there is not enough planning or purpose to include educational technology and good teaching practice during learning opportunities. It seems that the main intention of most learning opportunities is the delivery of knowledge by lecturers to learners.

In the new paradigm of OBE a study unit (e.g. Toothmorphology) has key learning points that include knowledge, skills and attitudes that represent the essence of the content that the learners must achieve. These key learning points, or specific outcomes, are what the curriculum intends for learners to master.

The following are the specific and sub outcomes for the study unit of Toothmorphology (Janse van Vuuren, 2000:21-35):

a. Specific outcomes

- A dentist should be able to identify any tooth of the human dentition correctly.
- A dentist should be able to restore pathology of the hard tissues (tooth) to the correct form and function.

- b. Sub-outcomes
- The learners should be able to describe (in oral and written format and by using drawings) the following:
- Form, arrangement and terminology of the different teeth in the dentition.
- Anatomy of the human tooth.
- Differences of the maxillary and mandibular central incisors.
- Differences of the maxillary and mandibular lateral incisors.
- Differences of the maxillary and mandibular canines.
- Differences of the maxillary and mandibular first premolars.
- Differences of the maxillary and mandibular second premolars.
- Differences of the maxillary and mandibular first molars.
- Differences of the maxillary and mandibular second molars.
- Differences of the maxillary and mandibular third molars.

These specific outcomes should be planned and facilitated in ways that accommodate and develop the diverse thinking style preferences in a group. According to Herrmann (1996:153) each key learning point should be incorporated in the learning activities using three or four of the different thinking style preferences. Using learning activities that accommodate the diverse thinking styles of the four brain "hemispheres" helps to stimulate or *turn* learners *on*.

This method of learning facilitation not only accommodates diversity but also helps development of learners' lesser-preferred thinking styles. By aligning educational tools and techniques during learning with strategic precision to each key learning point optimizes learning activities and minimizes learning avoidances.

3.2 Planning, implementing and facilitating 'whole brain' learning

3.2.1 Action Research as part of this study

As part of this study, the researcher as facilitator of learning implemented the principles of action research. The use of action research during the teaching and learning process has two major benefits: improvement of teaching practice and contributing to current knowledge in education (Hodgkinson & Maree 1998:51).

3.2.1.1 Definition of action research

Hodgkinson and Mareè (1998:52) emphasize the fact that there is no universally accepted definition of action research in literature, but for the purposes of this study a definition by Zuber-Skerritt (1992:1-2) defines action research as

> *collaborative, critical inquiry by the academics themselves (rather than expert educational researchers) into their own teaching practice, into problems of students learning and learning into to curriculum problems.*

This definition highlights the three areas that are 'researched' during the process of action research: teaching practice, student learning and the curriculum. Action research includes a critical inquiry into these three aspects in collaboration with other people (other academics or the students). It can be concluded from this definition that a lecturer uses action research during teaching and learning to evaluate the educational process as a whole critically in order to identify problems. When the 'researcher' diagnoses a problem, he or she uses this information to improve his or her teaching practice and thus improves student learning.

3.2.1.2 Action research models

There are currently a wide variety of action research models available. Hodgkinson and Maree (1998:54-58) summarize the following examples of action research models in three categories:

1. Stage models - Elliot's stage action research model
   - Ebbutt's stage action research model
2. Cyclical models - McLean's cyclical action research model
3. Spiral models - Stringer's interacting spiral action research model
   - Zuber-Skerritt's four-moment action research model
   - Kemmis's spiral action research model

3.2.1.3 Action research steps during this study

Every model displays a certain pattern of specific steps that is followed during action research. For the purpose of this study the researcher adapted and used the activity plan proposed by Hodgkinson and Maree (1998:61), that includes four steps during the action research process:

1. Planning

- The facilitator identified a general idea of what he wanted to achieve with the study.
- In the context of this study three problems were formulated (refer to p. 4).
- Research hypotheses were stated for this study (refer to p. 5).
- The literature was reviewed (refer to Chapter 2) concerning the new paradigm of OBE in South Africa. Different tools and strategies for facilitating learning in the context of OBE were reviewed. This review included a search into different learning style models available that included the Metaphoric Four Quadrant Whole Brain Model. For the purpose of this study the Whole Brain Teaching and Learning Model that was developed from the Whole Brain concept (p.85) was selected for the purpose of this study. The formulated problems and hypotheses were modified and refined to accommodate the use of this model as part of the study.
- A teaching and learning strategy was planned and learning activities prioritized.

2. Implementation

- The facilitator identified performance criteria for measuring the

effectiveness of the teaching and learning strategy that had been planned. The following questions tested the achievement of the criteria:

- Do the activities capture learner attention?
- Are learners stimulated by the various activities?
- Are the learners actively busy during group work?
- Are the learning activities appropriate for the specific content?
- Are learners motivated to attend the learning sessions?
- Do learners enjoy learning the study unit?
- Do the learning activities accommodate diverse thinking style preferences?
- Are the learning activities appropriate to develop thinking style diversity?

♦ Diverse learning interventions or activities were implemented.

3. Observation

♦ Evidence was gathered via questionnaires, field notes, direct observation and by using indirect observation through video recordings of learning sessions.

♦ The data was analyzed.

♦ Problems were noted and used for reflecting upon the teaching practice.

4. Evaluation

♦ The outcomes of the teaching practice and learning performances were reviewed by the facilitator and learners.

♦ The effectiveness of the teaching practice was evaluated by the facilitator and learners.

♦ The learners and facilitator made recommendations.

♦ By taking into consideration the outcomes of the evaluation process the facilitator modified teaching practice.

Action research facilitated other changes to the educational practice of the facilitator, which included:

♦ Adapting his own preferred thinking style to incorporate whole brain thinking while using the Whole Brain Concept during learning activities.

- Having a positive attitude during learning activities towards learners with diverse thinking preferences, especially towards learners with style preferences that do not match the style preference of the facilitator.
- Developing different creative and innovative learning materials and learning activities to accommodate and develop diversity in the group.

The use of action research helped the facilitator of learning to gather information continuously in a planned manner in order to construct and implement meaningful learning activities. One of the first steps before planning meaningful activities was to profile the individual learners and the group.

3.2.2 HBDI scores of the individuals and the group

The learners and facilitator completed the HBDI survey one week prior to the onset of the first learning intervention. The purpose was to:

- Create awareness by the facilitator for diverse thinking preferences of learners;
- Challenge the lecturer to innovate teaching strategies and learning activities in order to accommodate and develop learners during learning opportunities;
- Influence the attitudes of the learners (and facilitator) to meaningful learning positively, and
- To make learning more meaningful by using the Whole Brain Teaching and Learning Model.

After completing the HBDI survey each learner received a personal profile and accompanying booklet from Herrmann International (1999) that gave him or her more information about the Whole Brain Model and helped him/her to understand his/her personal profile better. In Table 5 the profiles were statistically analyzed.

Table 5: HBDI scores of the group

Learners	Profile code	Quadrant Score				Adjective Pairs			
		A	B	C	D	A	B	C	D
Female 1	1122	89	111	50	44	8	10	4	2
Female 2	3211	32	47	113	116	4	0	10	10
Female 3	3211	21	54	80	128	2	4	9	9
Female 4	2121	56	74	60	114	1	6	8	9
Female 5	2121	48	89	66	84	4	9	6	5
Female 6	1122	98	104	45	45	8	11	2	3
Female 7	1122	71	119	54	35	5	12	3	4
Female 8	3111	32	84	129	74	0	6	12	6
Female 9	1122	72	99	56	62	5	9	5	5
Female 10	2111	45	80	95	75	2	5	11	6
Female 11	2121	47	74	62	99	4	8	4	8
Female 12	2111	36	68	83	120	2	7	5	10
Female 13	3111	32	83	90	113	2	6	9	7
Female 14	1221	93	53	53	68	7	8	6	3
Female 15	2121	57	84	66	89	6	8	3	7
Female 16	2111	60	68	71	96	8	2	7	7
Female 17	2111	50	95	83	75	5	7	6	6
Female 18	2221	51	63	60	101	2	4	9	9
Female 19	2112	54	69	89	54	3	6	12	3
Female 20	1112	68	83	89	57	6	7	6	5
Female 21	2111	53	68	69	107	4	10	3	7
Female 22	1121	86	90	44	75	9	8	2	5
Female 23	2211	66	53	68	102	5	5	7	7
Male I	1221	92	71	51	75	7	7	2	8
Male 2	1122	77	111	62	54	4	9	8	3
Male 3	1112	86	72	75	57	7	4	9	4
Male 4	1122	84	75	66	53	6	9	5	4
Male 5	1221	77	62	56	102	7	4	3	10
Male 6	1121	71	90	56	81	3	5	5	11
Male 7	1121	87	78	56	69	8	4	5	7
Male 8	1122	89	75	66	53	5	4	9	6
Male 9	2121	62	102	66	71	5	9	3	7
Male 10	1221	95	66	51	93	7	3	7	7
Male 11	2121	45	93	59	105	5	6	8	5
Male 12	2211	63	45	98	86	3	2	10	9
Male 13	1211	92	45	71	78	8	3	8	5
Male 14	1212	78	62	69	60	5	5	10	4
Male 15	1122	96	102	50	51	6	7	6	5
Male 16	1121	83	89	45	80	6	8	4	6
Male 17	1122	105	89	41	59	8	6	3	7
Male 18	1222	92	66	60	54	11	8	1	4
Male 19	1132	113	93	32	53	10	6	3	5

Male 20	1122	83	107	65	36	7	8	6	3
Male 21	2111	39	84	75	84	1	7	11	5
Male 22	1111	75	68	72	84	5	8	7	4
Mean	1111	69	79	67	77	5	6	6	6

The following relates to Table 5:

1. Learners

N = 45

Female = 23 (51%)

Male = 22 (49%)

2. Profile code

Every profile will have at least one primary score, but could have as many as four. This consists of four numbers placed in order of the quadrants: A B C D. The terms primary (1), secondary (2) and tertiary (3) are used to designate the zones of the profile grid.

Primary (code 1) = total over 66. In a given quadrant a primary indicates a distinct preference for the type of activities relevant to that quadrant.

Secondary (code 2) = total 34-66. A secondary in the profile indicates a comfort zone in types of activities of that quadrant. It is still a preference, but clearly secondary to the primary (ies).

Tertiary (code 3) = total 0-33. A tertiary indicates a lack of preference and thus an avoidance of activities representative of the quadrant. In a profile, a tertiary reinforces the preferences of the primary situated diagonally opposite it.

3. Quadrant score

The quadrant score indicates the strength of preference a specific learner has for the four brain dominances or thinking modes (A B C D).

4. Adjective pairs

The four numbers appearing on the line 'Adjective Pairs' are the result of 24 forced choice pairings on the survey. This section pairs each descriptor with the other three quadrants.

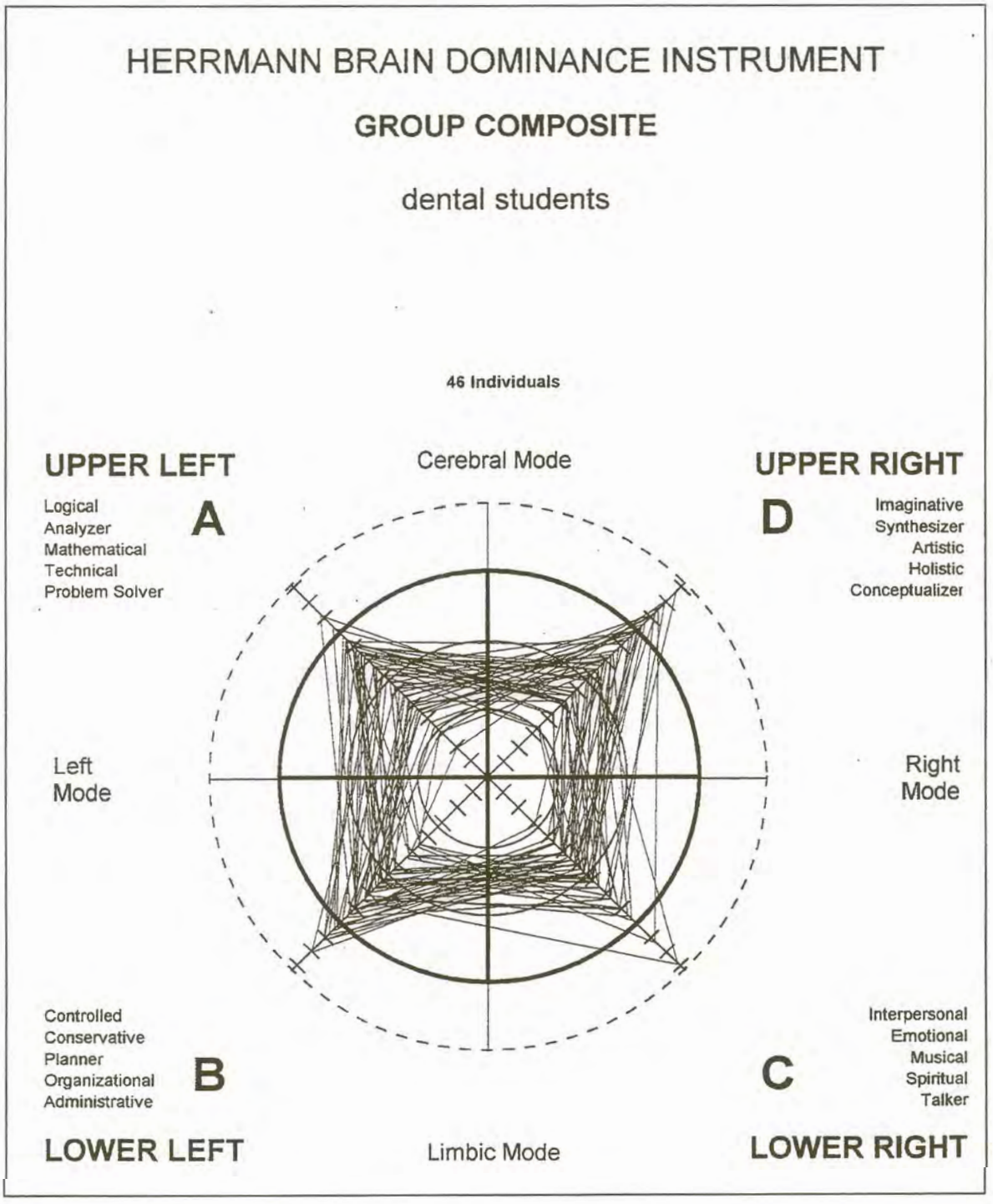
Experts in instrument design feel a balanced array of force-choice pairing like this adds to the accuracy of the personal profile. If the spread of these scores is in approximate correlation to the profile score, it shows entire consistency. If the score is significantly different, it indicates that the individual was somewhat inconsistent when completing the questionnaire.

From Table 5 it is concluded that group N represents a composite whole brain group, also revealed by the group composite profile in Figure 16 (p. 87). Data from a study of 5000 profiles done by Herrmann indicate that the aggregate total of all profiles gives a 1-1-1-1 (whole brain) profile. This is also evident of this group of learners with N = 1-1-1-1. Herrmann postulated that this would be true of most statistically significant groups of profiles.

Lumsdaine and Lumsdaine (1997:200) point out the advantages and usefulness of the HBDI:

- Students gain insight into their thinking preferences, which makes it easier for them to initiate successful learning strategies.
- The results are useful to facilitators of learning who can appreciate and understand student questions, comments and answers well in the light of their preferred style of thinking.
- The HBDI is useful in the construction of whole-brain groups during learning opportunities. Students develop easier understanding for those who are "different" and problems are solved more easily and more creatively in a whole brain group.

Figure 16: Composite map of the group



- The influences of curriculum changes on student thinking skills can be measured.
- Faculty members gain insight into their own cognitive and mental preferences, especially the members that feel isolated or left out.

3.2.3 Whole brain teaching strategies to facilitate learning

Different strategies and activities were used during this study to accommodate and develop diverse thinking styles of learners during learning interventions. The aim was to accommodate learners, preferred modes of thinking, but also to develop learning in all four quadrants. In Tables 6-9 the learners' expectations in each of the four quadrants or brain dominances during learning are described as well as the teaching strategies the facilitator of learning used to facilitate learning in the study unit of Toothmorphology.

Table 6: Teaching strategies to facilitate learning for A-quadrant thinking style preferences

Expectations of Learner	*Strategies of Facilitator*
♦ Precise to the point information. ♦ Listening to informal lectures. ♦ Theory and logical rationales ♦ Proof of validity. ♦ Research references. ♦ Textbook reading. ♦ Quantifiable numbers and data sets. ♦ Problems. ♦ Subject matter expertise. ♦ Opportunity to ask challenging questions.	♦ Various textbooks on the study unit were made available to learners during learning interventions. ♦ Clinically orientated articles on the subject were collected from scientific and other journals and made available to learners during learning interventions. ♦ Real-life case studies were constructed and used by the facilitator to present learning activities in a problem-based format.

	♦ Short informal lectures were used as part of introductions, orientation, conclusions and summaries during learning sessions. ♦ The facilitator was available as an expert on the content for advice and guidance during learning.

During learning the facilitator did make use of only short informal lectures during the introduction, orientation and summary of learning material. Various textbooks on Dental Anatomy including Toothmorphology as well as appropriate articles in dental journals were available to learners. Learning included solving real-life problems while the facilitator acted as an expert who gave learners advice during learning. Learners had to analyze problems (see example: Appendix D), collect information on the problem by using textbooks and clinical articles and produce possible answers.

Table 7: Teaching strategies to facilitate learning for B- quadrant thinking style preferences

Expectations of Learners	*Strategies of Facilitator*
♦ Organized consisted approach. ♦ Listening to detailed lectures. ♦ Taking detailed notes. ♦ Staying on track and on time, making time management schedules. ♦ Complete subject chunks. ♦ Beginning, middle and end. ♦ Opportunity to practise and evaluate.	♦ A separate study manual for the study unit of Toothmorphology was handed out that included ground rules for learning opportunities as well as the assessment (whole brain) practice. ♦ Information on the Whole Brain Concept was delivered to learners via an introductory learning session and handouts. ♦ Every learner received a detailed

- Practical applications.
- Examples.
- Clear instructions and expectations.
- Frequent repetition.
- Want to follow directions and do not want to try something in a different way.
- Testing theories.
- Writing a sequential report on results of experiments.

analysis and description of his or her brain dominance profile.

- Every learning session was organized on the whiteboard by using visual time frames for each activity during learning.
- At the end of each learning session the facilitator summarized the learning that took place during that session and related it to the specific outcomes of the study unit.
- The learners had to keep record of all their previous learning and learning material
- Learners were regularly informed how and when they will be assessed
- The facilitator acted as co-manager, co-organizer and co-administrator during learning.

Together with the individual profile each learner received an interpretation and explanation of their own profile. During the first learning opportunity the learners were instructed on the Whole Brain Model to make sure everybody understood the reasons for and conditions of learning via the Whole Brain Concept. During this session the facilitator also outlined the rules that were to be followed during learning to make sure that everybody was more secure. The following are the ground rules and conditions that were set during learning via the Whole Brain Teaching and Learning Model:

- Everything that happens during learning in the classroom is confidential.

- No discrimination between peers is allowed during learning.
- Everybody has an equal chance to ask questions and speak his or her mind.
- No fun or jokes are allowed when somebody has done something wrong or stupid.
- Respect for one another is imperative.
- Learners must be spontaneous and enjoy learning.

A separate study manual, organizing the specific outcomes of learning in this study unit, was supplied to the learners. The facilitator adapted the study-manual (micro-structure level of the curriculum) for the study unit of Toothmorphology to include the principles of the Whole Brain concept. Learning sessions were presented using a time schedule that clearly outlined the intended activities that would take place during a session. At the start and the end of each learning session the facilitator orientated the learners' learning according to the specific outcomes and related it to the critical outcomes.

Table 8: Teaching strategies to facilitate learning for C-quadrant thinking style preferences

Expectations of learner	*Strategies of Facilitator*
♦ Group discussion and involvement. ♦ Meeting new people. ♦ Sharing ideas. ♦ Expressing feelings. ♦ Doing role-play or physical acting out. ♦ People orientated case studies. ♦ Learning by teaching others. ♦ *Prefer video to audio learning* material. ♦ Moving around (kinesthetic).	♦ The learners had to work in groups of three. ♦ Music was played during learning sessions at selected times. ♦ The facilitator used stories from personal experiences in private practice to give better meaning to important aspects of the content. ♦ *Sessions included physical* activities, e.g. walking around to collect data, presenting a short

- Hands-on learning.
- Respect for and from others.
- Personal connection with lecturer.
- Emotional involvement.
- User-friendly learning experience. Use of all the senses.

drama, scenario or role-play as a group in front of the class.

- Learners were encouraged to move around and speak to their peers in other groups when necessary.
- The facilitator provided personal help to learners with learning or personal problems.
- Mutual respect and appreciation were shown to all learners for their contributions during learning activities.
- A warm and friendly mood or atmosphere was maintained during learning.
- The facilitator acted as a mentor, motivator and friend during learning.

During learning sessions the facilitator played music softly in the background while group work was commencing. The learners were invited to supply the music they prefer for learning opportunities. The learners were divided into heterogeneous, whole brain groups during the first learning opportunity. The brain dominance profiles of the three learners in a group had to include dominances for all four quadrants. The heterogeneous groups were used during the whole study. There was freedom and motivation to move around during learning and activities such as drama, scenarios and role-play were used to activate learners' thinking and moving around during learning activities. Learners had to interpret cartoons about an "intervention in the dental chair" or advertise a "new toothbrush" to the class. The facilitator used stories from his own professional experience to present real-life problems. The facilitator was

available on a continuous basis to help learners with personal, learning and other problems.

Table 9: Teaching strategies to facilitate learning for D-quadrant thinking style preferences

Expectations of Learner	*Strategies of Facilitator*
♦ Fun and spontaneity. ♦ Surprising and playful approaches. ♦ Pictures, metaphors and overviews. ♦ Discovering of the content. ♦ Freedom to explore. ♦ Quick pace and variety. ♦ Opportunity to experiment. ♦ New ideas and concepts. ♦ Looking at the big picture, not the facts or detail. ♦ Taking initiative and getting involved. ♦ Brainstorming. ♦ Problems with many possible answers. ♦ Playing with new ideas. ♦ Exploring hidden possibilities. ♦ Thinking about the future. ♦ Future-orientated case discussions. ♦ Come up with something new. ♦ Thinking about trends. ♦ Relying on intuition.	♦ Learners had to introduce themselves to the class by using a metaphor. ♦ The learners and facilitator had much fun during the drama-like presentations of scenarios and role-play. ♦ Colourful innovative learning materials made learning fun and interesting. ♦ A variety of drawings and sketches to illustrate content were used. ♦ The various textbooks available to learners brought variety into the classroom. ♦ Movie-clips on video and cartoon pictures from magazines were used as icebreakers or during a learning session to stimulate learners. ♦ Futuristic design activities were used as introductions, e.g. designing the toothbrush of the future. ♦ Future-orientated discussions were

used to show the relevance of the content in a clinical working situation on a real patient.

- Real-life pictures from magazines and clinical journals were used to bring life to the content
- Videos that were previously made by a colleague for the study unit of Toothmorphology were shown to learners during learning sessions
- The learners had the freedom to construct and deliver their own project that would incorporate what they had learnt during the learning sessions in a whole brain manner

Interesting learning designs and learning materials were used during learning opportunities, which helped to construct an element of intrigue, surprise and excitement throughout the course of learning. A lot of different colours, patterns and designs were used for learning materials. Role-play, scenarios and metaphors set the scene for fun and spontaneity during learning, and were used as icebreakers at the start of a session or as an energizer in the middle of a learning session.

A short clip from a movie and some cartoon pictures, all about dentistry, were used to stimulate learners, create an atmosphere of fun and spontaneity and to help learners to be active and overcome boredom during learning activities. The content was illustrated using real-life pictures and videos on Toothmorphology. As a final outcome of learning the learners were given a task to construct their

own whole brain model on Toothmorphology giving them the freedom to demonstrate in the format of their choice what they had learnt in this study unit.

The facilitator attempted with innovative and creative learning design and activities to accommodate the diverse preferences of the whole group that represented an equal distribution of all four thinking modes.

3.3 Assessment

3.3.1 Traditional assessment in the study unit of Toothmorphology

The total educational strategy includes three important aspects: *curriculum development, teaching practice* and *assessment.* Assessment is that part of the educational process where what the learner has learnt is measured against set criteria or outcomes. This can be done during learning or at the end of learning. There are two types of assessment that are used to measure the learning performance of learners (Malan & du Toit, 1991:153) - assessment with a formative function and assessment with a summative function.

a. Formative assessment
- takes place during instruction
- ideal to be used continuously during learning
- learner gets continuous feedback of performance that helps to manage learning
- more informal and low stress to learners
- used for learner's benefit

b. Summative assessment
- takes place after instruction in the form of an examination or semester test
- more formal and high stress to learners
- used for certification purposes or society's benefit

Traditionally in the study unit of Toothmorphology, as with most other study units in the curriculum, the learners' performance is assessed by using mostly summative assessment and only a few formative assessment interventions.

3.3.2 Assessment in the new paradigm of outcomes-based education

Assessment plays an important role in the new paradigm of OBE. It is used to collect evidence of learner development and achievement. This helps the facilitator of learning to manage the learning process in order to make learning more meaningful.

Assessment forms an integral part of the teaching strategy and learning activities in OBE. Assessment is multidimensional, aiming to measure different aspects of learning, including skills and processes as well as knowledge and attitudes. A practice of Continuous Assessment (CASS) that places the emphasis on formative assessment of learners' work over a period of time by using different assessment strategies is proposed by SAQA (1997:25). This assessment practice can include the following strategies:

- Self-assessment
- Peer-assessment
- Portfolio-assessment
- Performance assessment
- Observation sheets
- Journals
- Teacher-made tests
- Assessment of prior learning
- Diagnostic assessment
- Achievement-based assessment

3.3.3 Assessment as part of this study

Facilitators of learning in higher education agree that assessment drives learning. This illuminates the fact that when developing the curriculum, assessment must be incorporated and used to drive meaningful learning.

During this study assessment was incorporated as a necessary and important aspect of the total educational strategy (curriculum design, learning and

assessment) geared towards meaningful learning and maximizing human potential. Assessment was not only used to measure *what* (content) the learners should learn but also *why* they have to learn it (to become competent and skilled) *and how* they should learn (outcomes-based learning, whole brain learning).

Diverse assessment strategies were planned and aligned with the teaching practice according to the Whole Brain Teaching and Learning Model as well as to the specific outcomes of the study unit of Toothmorphology. The following strategies for assessment were implemented:

- *Facilitator-made tests:* Tests were given during learning sessions and included questions about the facts and detail of the study unit. It also included (holistic) questions on the relevance of Toothmorphology in a clinical situation, placing responsibility on the learners to incorporate what they have learnt into one answer. Learners also had the opportunity of assessing one another's answers (peer-assessment) to these tests.
- *Self-assessment:* Learners assessed their own knowledge, skills and attitudes during learning as part of the weekly feedback via a questionnaire (Appendix B).
- *Peer-assessment:* Learners measured the knowledge, skills and attitudes of their peers in their own group as part of the weekly feedback via a questionnaire (C quadrant).
- *Other assessment:* Learners received an assignment where they had to produce something that would demonstrate what they had learnt in the study unit of Toothmorphology in a whole brain format (Appendix A).

Assessment assisted the facilitator of learning and learners to monitor learning performance continuously against the specific outcomes. The use of "whole-brain" assessment during this study also helped accommodating and developing diversity in thinking and learning.

Formative assessments consisted of tests written during learning sessions; a final test at the end of the series of learning sessions constituted the summative assessment. Summative assessment was done for the sole purpose of promotion.