

CHAPTER 1

INTRODUCTION

The study of learning breakthrough originated with the researcher's own experience of a learning event. The researcher could not explain the event through his own experience so he decided to further explore this new aspect of his learning capability.

To introduce the study, the researcher will describe his learning experience and in doing so provide some detail which will flow into the study.

At the time of the happening the researcher was enrolled in a course for learning about computer programming. There were fourteen other students in the class with a teacher and, to assist the learning process, computers. The particular activity in which his breakthrough occurred was experimenting with computer program routines aimed at helping the researcher understand computer concepts. Learning breakthrough was unexpected. There was a period of misunderstanding and while still expecting more difficulties he suddenly understood. What had eluded him a moment before as a concept of computerisation eluded him no more - the consequence of the unique event was a transformation of his understanding about computers. On reflection what had occurred then allowed the researcher to progress with learning about computers. The researcher, to prove to himself his understanding, immediately turned to the student seated adjacent to him and explained the concept. Occurring suddenly with a complete understanding was, to the researcher, a curious, extraordinary learning experience. In addition, to support this characterisation, he was the only one in the class group to experience such a phenomenon at that time.

The researcher's experience was accompanied by an elated feeling discussed later as a reason for him remembering the occurrence so vividly.

It was remembered as the moment he gained a new skill to solve problems with computer programs instead of mechanically transferring words from a text to the computer. What was perceived was a transformation from a vague use of routines and computers to a meaningful use of routines and computers.

The phenomenon did not immediately arouse interest. At the time, in mid 1984, computer programming was more important. However, once the course was finished there was time to think about what had happened. Given the opportunity to reflect on the occurrence, a fascination with this curious experience began to develop. The term 'learning breakthrough' was adopted as the researcher's preferred way of describing the phenomenon to others - 'learning' because that was what occurred 'breakthrough' because, to him, the word is synonymous with events which break a barrier, such as a learning barrier.

The researcher is a teacher of adults and, while teaching, the thought occurred: do learning breakthroughs occur to others? A convenient method for gaining answers was sought. A means presented itself through discussion with other learners. Talking with students provided one way of inquiring about similar experiences from a learner's point of view. A broad description of the experience was offered with the familiar narrative: "This is what happened to me.". Another means of inquiry was from teachers who may have observed such phenomena. There were many oral reports of breakthrough experiences which suggested the occurrence was not rare.

Through a discussion with a wide ranging group of learners and teachers, it became evident learning breakthrough occurred during a wide variety of activities and with many people. One example, was from a woman who was learning to scuba dive and it occurred while she was at the bottom of a swimming pool. This learning breakthrough indicated the possible far reaching nature of the phenomenon, that it may happen in life situations and not just in the traditional classroom as in the case of the researcher.

What followed after hearing about these types of events was the researcher searching through general educational literature concerned with learning phenomena and books concerning scientific discoveries. The search, expected to enlighten and inform the researcher on the issues raised by the learners and teachers who gave their stories, provided part of an answer.

The early searches provided examples of people observing learning experiences and reports of experiments that explored learning, but, there was no study found which adequately explained what is learning breakthrough? The researcher found minimal information concerned with learning breakthrough, particularly to explain his own and the accounts described to the him during his early exploration. What did occur however was a greater understanding of the researcher's own experience. As a result, the researcher proceeded to document his own experience with a view to identifying additional characteristics to those few identified above with the researcher's own learning breakthrough namely that it was sudden, extraordinary, experienced alone and resulted in understanding.

In summary, (a) the researcher had an experience which he named a learning breakthrough, (b) he spoke to other adult learners to find that this experience was a common occurrence, (c) he looked in the literature and found minimal information to provide an explanation of the experience, and (d) he documented his personal experience as a beginning step to exploring learning breakthrough. Encouraged with the prospect of finding an answer to what is learning breakthrough, the researcher initiated a more structured investigation.

THE AIM OF THE STUDY

The aim of the study is to clarify the concept of learning breakthrough so that the experience of learning breakthrough, by the researcher and others, can be explained.

THE SCOPE OF THE STUDY

The scope of the study concerns the limits to which the researcher intends to examine the phenomenon. The exploration will produce conclusions, but they have limited validity and applicability.

THE SIGNIFICANCE OF THE STUDY

By the significance of the study is meant the contribution towards better educational practice - directed both to educators and adult learners.

The study is seen as having a potential for helping learners identify how they are able to articulate details of major learning events in their lives and gain from reflecting on learning breakthrough occurrence. In addition, the study will enable teachers of adults to be aware of the pre-conditions, circumstances and effects of learning breakthrough.

As a result of this exploration, it is envisaged that the findings will be a basis of knowledge on which to initiate further studies.

THE OVERVIEW OF THE THESIS

The thesis is structured as follows.

Chapter 2 reviews literature concerned with learning breakthrough phenomena and addresses terminology, features of learning breakthrough and the notion of self-reporting breakthrough experience.

Chapter 3 explains the development of the conceptual framework.

Chapter 4 reports on the methods used to collect and analyse data.

Chapter 5 reports the conceptual analysis of the individual learning breakthrough experiences. This chapter contains the researcher's interpretation of learning breakthrough through, and in terms of, the conceptual framework.

Chapter 6 reports the conceptual analysis of common features of learning breakthrough based on the eight reported experiences.

Chapter 7 provides the conclusions and discussion. The chapter summarises the general features of learning breakthrough which emerge as a result of examining the individual experiences in Chapter Five and the synthesis of Chapter Six. Chapter Seven provides conclusions and discussion with a focus on adult learning aimed at understanding the phenomenon of learning breakthrough as experienced by the researcher and the adult learners contributing to the study.

COMMENTS

This chapter identifies personal reasons for understanding learning breakthrough and the researcher's expressed need to explore the experiences of others.

The following chapter is the literature review. It is through the review that the researcher will establish the context for this study.

CHAPTER 2

THE REVIEW OF LITERATURE ON LEARNING BREAKTHROUGH

INTRODUCTION

The literature review on learning breakthrough is a review of books, articles, monographs and papers, concerned with human learning and written by adult educators, mathematicians who relate to the experience of learning breakthrough, and psychologists discussing learning and its function.

This review is an exploration of what other people have written about phenomena similar to the researcher's learning breakthrough.

The review is organised under two headings. They are:

- Defining the Core Concepts.
- Features of learning breakthrough.

DEFINING THE CORE CONCEPTS

The review shows how core concepts are used in the literature. By 'core concepts' is meant terms used to express the experience of learning breakthrough or similar experiences. Defining the core concepts explores general aspects of learning phenomena of which learning breakthrough is a part.

While the term 'Learning Breakthrough' was not found, other terms describing similar phenomena were used in the literature and are discussed in this section. This section will further clarify terms to reduce the possibility of confusing terms and concepts. Defining the core concepts will also show how appropriate terms are used throughout the thesis.

Following his learning breakthrough experience, the researcher made a brief exploration of literature in an attempt to clarify just what had occurred and what was involved.

The first reference was Kidd (1973:307), he wrote:

All I have to do is to speak to him of some transforming idea and then watch him light up just as an electric bulb does when the current is connected.

From what Kidd describes, the researcher recognised qualities perceived from his own experience. Firstly, Kidd describes a learning experience. Secondly, there is an extraordinary quality. Thirdly, learning is presented as sudden and unexpected and, finally, there is a perceived breakthrough.

Reflecting on his own experience and that described by Kidd, the researcher identified seven characteristics or qualities of the phenomenon. They are:

- extraordinary
- sudden
- unexpected
- internal process
- barrier breaking
- new understanding
- excitement

These characteristics provided the researcher with his initial understanding of the initially un-named experience. To give the experience an identity and simplify the seven characteristics into a descriptive label, the researcher chose 'Learning Breakthrough' because the event was a learning experience and it broke a barrier preventing the researcher from progressing further with computer programming.

The next task was to find out what terms the literature used to describe experiences of a similar nature. It became apparent from examining the literature that terms used to describe learning breakthrough can be categorised into two groups, inappropriate and alternative.

Terms that may be confused with learning breakthrough include: major terms in the psychology of learning, 'recall' and 'recognition', and variations of these; and minor terms like 'tip of the tongue' and 'feeling for knowing'. These terms do not in themselves describe learning breakthrough. They are not representative of the broad concepts or far reaching nature of the phenomenon. They are seen here as only possible parts of a more complex experience described by the seven characteristics identified earlier.

'Creative thinking' is identified as a conscious activity of thinking in new ways, "...marked by the ability to think divergently, that is, to think in unusual or atypical ways about a topic." (Lerner et al. 1986:271). 'Creative thinking' is not always unexpected, it is a choice or way of thinking. When compared to the qualities of learning breakthrough identified above creative thinking is not seen as being extraordinary, though it may be novel. It is not considered a sudden process nor would it satisfy the description of an instance which lifts a learning barrier.

'Intuitive learning' refers to a mode of learning. The term refers to a regular process of acquiring knowledge, skills, habits or actions without recourse to objectives, goals or consciously planned steps (Denis and Richter 1979:25). Some writers (Denis 1979) also make the distinction that intuitive learning should not be confused with terms like intuition and insight to highlight the characteristic of how intuitive learning relates to ordinary learning behaviour. Denis, cited in Denis and Richter (1979:25), explains that:

Intuitive learning, as a mode of learning, differs from intuition in that the former is a process extending more or less over time; intuition is a sudden insight, instantaneous in occurrence.

The point is that learning breakthrough is not an ordinary process extending over a period of time as 'intuitive learning', and as seen through the researcher's experience. The word 'intuition' alone was also confusing when related to insight which is seen later to be the result of learning breakthrough, "...sudden insight...".

'Insight' is the final term in the category of inappropriate terms. The term is used by writers and theorists of learning and problem solving to describe occasional, unplanned responses, not necessarily conveying feeling. However, learning breakthrough, from the researcher's understanding of the phenomenon, is an internal step in a process occurring prior to any insight. Ernest (1987:10) provides an explanation of 'insight' which supports the notion that the term does not necessarily convey process. He writes describing insight as the outcome of "...some internal process". Rock and Palmer (1991:60) also write that insight results from an unconscious process experienced by the learner. Learning breakthrough, which is a process, is not insight, but as human behaviour which may result in insight.

When the term is used by Gestalt psychologists, who view the world as made up of patterns and shapes 'insight' is used in the broad sense of a whole experience which they see happening in a particular way. (Scheerer 1963, Wertheimer 1959, and Köhler 1947). Learning breakthrough, as the researcher suggests, would be part of those gestalt patterns or shapes forming the insight response. The Gestalt use of the term 'insight' is too broad limited to describe the researcher's experience. 'Insight' or the 'Gestalt' can be the product or outcome of learning breakthrough, but does not describe the process.

Behaviourists in their perception of the world of learning phenomena view insight as a demonstration of instant knowledge, because they accept the overt measurable aspects of learning and argue that to every action there is an equal and opposite reaction and nothing is covert. Theorists who study behaviour not the mind or mental activity, for example Watson (1919) and Skinner (1974), are seen here to use insight in a more specific way, describing as 'insight' exceptional understanding occurring after some learning process has taken place. For example, Dominowski (1981:194) argues that insight is a consequence of prior learning rather than a cause. The behaviourist use of the term is too limited to fit the researcher's experience because the process is only one concern.

To illustrate another difficulty with the use of the term, Clement (1988:56), in his deliberation of creative thinking in science, uses the term to describe a breakthrough. He writes.

A scientific insight is a breakthrough occurring over a reasonably short period of time leading to a significant structural improvement in one's model of a phenomenon. That is, it constitutes a shift from the subject's previous way of representing the phenomenon and leads to an increase in understanding of the phenomenon...(emphasis added)

Clement's (1988) definition gave rise to another dimension of confusion because here is evidence of someone using the term to take into account the innate process which learning breakthrough conveys. Clement's use of the term 'insight' illustrates confusion with the researcher's perception of learning breakthrough. Insight, as Clement indicates, is resultant understanding, but, learning breakthrough is a process or as the researcher, Ernest (1987) and Rock and Palmer (1991) maintain, may cause that understanding. Therefore, the term as used by Clement would be misleading.

Alternatively, terms used in the literature to describe learning breakthrough such as 'Eureka', 'Aha! experience', and the single word 'Breakthrough'. These terms were used to describe concepts or events and the process and the results consistent with what the researcher defines as learning breakthrough.

The term 'Eureka', for example, is used to convey "...an exclamation of triumph on discovering or solving something." (Hanks et al. 1979:504). The word in this context was first used by Archimedes (Greek mathematician and physicist 287-212BC) when he realised, during bathing in a public bath, that the apparent loss in weight of his own body when immersed in fluid is equal to the weight of the fluid displaced (Encyclopedia Britannica 1989:529-30). Relating this to the researcher's experience, Archimedes experienced something resembling a learning breakthrough because it was; (a) an extraordinary experience of sudden occurrence, (b) unexpected when it occurred, (c) an unconscious process effectively breaking barriers which held back Archimedes' understanding, (d) a new understanding emerged, and (e) a feeling of joy made obvious by the way the story is told of his response running naked in the street shouting eureka! eureka!

Clement (1988) defines eureka experience as extraordinary moments in an experience of discovery. Clement's (1988:57) definition appears to involve no ordinary reasoning processes of conjecture, playing with ideas, making inferences and so on which were not seen to be involved in the researcher's learning breakthrough to suggest a term consistent with describing an instance of similar extraordinary qualities. He writes:

A pure eureka event is a scientific insight where: (1) there is an extremely fast emergence of a new idea with little evidence of preparation; (2) the new idea is a whole structure replacing the subject's previous model or understanding of a situation; (3) the process is not explained via ordinary reasoning processes; extraordinary thought processes or unconscious thought processes are involved. (emphasis added)

For this study Clement's definition of a 'Eureka' events reveal qualities consistent with the experience of the researcher, that is: (a) sudden, (b) unexpected, (c) insight as a consequence, (d) breakthrough to new understanding, (e) extraordinary, and (f) unconscious thought processes. Add the elation showed by Archimedes and all the features of learning breakthrough identified by the researcher are described using the term 'Eureka'. 'Eureka' is adopted as an acceptable alternative term.

'Aha! experience' is used by Ernest (1987:10), Rock and Palmer (1991:60), and Gardner (1978:vii) to describe the public exclamation of a surprise inner event or experience. The term often accompanies a report of sudden extraordinary learning. Ernest (1987:10) writes concerning students he observed experiencing sudden learning phenomena. He refers to 'Aha!' as an exclamation associated with an unconscious process of momentary duration leading to a new understanding. He explains what he observed as follows:

During these moments, the child may say 'Aha...' or 'I see...' as they make a mental leap. Sometimes the child is silent, wearing an expression of concentration, as some internal process leads to the insight. Sometimes the moment slips past unobserved. At one moment the child is without the insight. A few seconds later the insight is being applied in a problem situation. (p.10)

Ernest's 'Aha!' and the associated experience has seven recognisable qualities of learning breakthrough as established earlier, extraordinary, sudden, unexpected, internal process, producing new understanding and to typify the 'Aha! experience', elation.

Rock and Palmer (1990:60) make the distinction that the 'Aha! experience' is an explanation for a person who suddenly finds a dramatic new understanding of a solution to a problem. The 'Aha! experience' they claim is:

When people let go of implicit assumptions, their understanding of a problem is sometimes dramatically reorganised, enabling them suddenly to 'see' the solution, complete with the accompanying 'Aha!' experience.

Gardner (1978:vii) uses the term to describe the outward expression when some extraordinary experience happens, but Gardner, like the other writers, uses the term to describe the extraordinary event not just the public announcement. Gardner identifies Aha! with the response a person makes on experiencing a reaction to solve a problem.

If you can free your mind from standard problem solving techniques, you may be receptive to an Aha! reaction that leads immediately to a solution.....

The point being made is that the term 'Aha! experience' describes the expressions people often make after experiencing extraordinary, sudden, unexpected learning phenomenon, (learning breakthrough). Learning breakthrough was pleasurable for the researcher and as indicated from Ernest (1987), Rock and Palmer (1990), and Gardner (1978) with the

exclamation of Aha!, is seen as an emotional experience and the term, 'Aha! experience', is used where an emphasis on emotion is needed.

There is also the single word 'breakthrough'. Clement (1988:56) uses the term in a specific way and defines it as follows.

A breakthrough is a process that produces a key idea - an important component of a solution - and that overcomes a barrier that can block progress towards a solution. (emphasis added)

Here, he uses 'breakthrough' to describe a process and what it produces. Inferred also is the notion of the breakthrough overcoming a barrier which has blocked progress. Clement (1988:50) goes on to argue that "...breakthrough adds significantly to the subject's knowledge.". It produces "a large structural change in the subject's model..." where he or she: (a) "...identifies new variables or causal factors in the system"; (b) "...identifies a new hypothesised mechanism in the form of an explanatory model"; and (c) "...states that it increases his understanding which can lead to a rapid improvement in conceptual understanding." (p.78).

What is inferred is the impact on learners themselves - a transforming part inherent in the learning breakthrough experienced by the researcher. Transformation is a quality not previously noted. Learning breakthrough effects a transformation in the learner.

In other references, the term 'breakthrough' has been used to describe a moment in a series of occurrences directed at developing skills. Niensted (1970) writes that what she had observed in pupils was a breakthrough in acquiring a reading process. She writes:

Work with disabled readers during three phases of behaviour, (1) before breakthrough in acquiring a reading process, (2) at the time of the breakthrough, and (3) after the breakthrough; provides insight into how a reading process is acquired.

What her explanation of a learning process provides for defining the core concept 'breakthrough' is a three step sequence of events, before, during and after. Learning breakthrough from this and the researcher's occurrence provides evidence of a broader experience existing in the past, present and future. The term use here of the word 'breakthrough' conveys a process of change which is a further quality for describing learning breakthrough as perceived by the researcher from his own experience.

What this illustrates for the study, and not seen with any other research thus far, is the broad nature of the phenomenon.

The term 'breakthrough' is also used colloquially. Schmalz (1989:685) uses the term to explain that "...an emergence of new insight is frequently called a breakthrough.", and Jacques Hadamard (1949), in the same article was cited as referring to breakthrough with mathematical people "...waiting for, and the emergence of, new insight."(p.686). Kawada and Johnson (1993:33) are accountants and they use the term to describe a breakthrough in thinking to solve an apparently insoluble dilemma. 'Breakthrough' is a valuable alternative term conveying that learning breakthrough is a change process and the change in the learner is seen as a transformation of their thinking or skill.

As a term which conveys the researcher's account of learning breakthrough, the combined words learning and breakthrough as chosen for use in this study can therefore be seen to have been developed from the work on eureka, Aha! experience and breakthrough. Intrinsic to those words are:

1. **Learning** conveys the inner process and the change to become a transformation of the learner.
2. **Breakthrough** conveys lifting of barriers, extraordinary incident of sudden duration, unexpected and having a quality to produce pleasurable emotions.

The other core concepts or terms used selectively will draw attention to particular aspects of the experiences talked about by participating learners and in describing the phenomenon throughout this study.

In summary, terms cognate to 'learning breakthrough' are:

Eureka
Aha!
Breakthrough

The terms which fall outside the field of direct concern are:

Top-of-the-tongue
Feeling for knowing
Recall
Recognition
Creative thinking
Intuitive learning
Insight

This part of the review of literature has served to identify, nine qualities of the phenomenon learning breakthrough perceived by the researcher. They are:

- extraordinary
- sudden
- unexpected
- internal process
- barrier breaking
- new understanding
- excitement
- transformation
- change process

In addition, the term 'learning breakthrough' has been identified as the appropriate term for describing an event with such qualities.

The following section will show how previous research was carried out, and develop major features of learning breakthrough to further illustrate the nature of the occurrence from other reports found in the literature on learning breakthrough.

FEATURES OF LEARNING BREAKTHROUGH

The features of learning breakthrough labelled below are descriptors drawn by the researcher from the qualities he saw emerging from the reports of cases in the literature.

1. Singular
2. Cognitive
3. Unexpected
4. Instantaneous
5. Transformative
6. Pleasurable
7. Memorable

The relationship between these features and the nine qualities identified from the researcher's own experience are explored below.

The purpose of this section of the review is to: (a) explore features from other research, (b) identify the elements of an appropriate conceptual framework through which to structure the subsequent study, and (c) provide the basis on which to make comparisons of contrast or similarity with features identified in this research study.

The seven features are used as sub-headings to structure this section.

Singular

By 'Singular' is meant the learning breakthrough is perceived as the lifting of a specific barrier to learning, explained by researchers in various ways, but, emphasising the one aspect which causes the learner difficulty - that which eludes them and is a barrier to their progress. Learning breakthrough is now seen as a singular incident overcoming a specific barrier.

As an example to illustrate the feature, the researcher found a reference by Dominowski (1981:197) who explains that before insight a learner might first "...gain insight into the relation between a parallelogram and a rectangle.". The relationship is seen as the barrier to be lifted or grasped. From what Dominowski explains recognising a relationship between two figures was a single act of recognition and the relationship was a specific element of mathematics. Therefore, learning breakthrough was a single incident overcoming a specific barrier.

Another example is sounding letters to pronounce words to prepare a student for reading. Learning a single element such as sounding the "t" in apartment is described by Niensted (1970:6) and seen here as an instance of learning breakthrough. The "t" is not important, it could be any letter. What is important to learning, and learning breakthrough, is associating the sound with the word's meaning. This particular use of association was a single act in the learning process for Niensted's student and the elusive "t" was the specific barrier. In Niensted's (1970) words (after observing a male pupil experience an Aha! with learning breakthrough):

Mid-way in the fourth session as he traced the first t in apartment, he sucked in his breath, and ejaculated the word, "why!" not as a question but as an expression of surprise. He turned to me, smiled, and immediately turned back to the tracing which he did rapidly (p.1). (emphasis added)

The point is that during remedial reading classes where a male student was helped in his reading by physically tracing across the letters in words he had made some connection - a unitary element in his learning breakthrough. He apparently went on to read with ease.

Niensted also reports another learning breakthrough where a female student grasped a single reading skill to comprehend what she read. In Niensted's (1970:7) words, she (the pupil),

...read a third sentence and again recalled only the subject. I pronounced only the words, "What about..." when the girl interrupted, "Oh! I get it...". She immediately gave the complete thought expressed in the sentence.

The learning breakthrough to attain "...Oh! I get it...", the pupil had made some sort of association to comprehend the message. The examples of singularity with Niensted's (1970) students are, perhaps, identifying in each case a unitary cognitive step occurring during learning breakthrough.

Examples of grasping specific elements also came from problem solving experiences. Ernest (1987), for example, observed during an Aha! experience that a student in a mathematical problem solving exercise made a single conjecture to realise a rule, solution. The student evidently realised he was on the wrong track for solving the problem when suddenly he grasped and applied a rule, which worked. Ernest (1987:11) relates to the incident as follows. He writes:

In a magic moment these components (of triangles) gelled in a conjecture relating the number of rows to the number of unit triangles (drawn within a triangle).

The single act intrinsic in the expression "...gelled..." may be seen here as recognising a rule for conjecture within the more complex arithmetic of what he was doing. The "...magic moment..." is demonstrated through applying the rule.

There are two examples of adults explaining their experiences of grasping single elements to further explore this feature. The first example is explained by a mathematician, Henri Poincaré as Penrose (1991:541-2) relates. Poincaré's learning breakthrough experience was understanding the match between two geometrical functions. While very complex in mathematical terms the seemingly unitary learning breakthrough instance was a "...'single' idea able to be fully comprehended in one moment!" (Penrose 1991:542). It is here that someone other than the researcher has recognised the possible existence of a single incident in a broader experience of learning breakthrough.

The second example is cited in Denis and Richter (1988:25). They explain that the single act at the point of breakthrough is a "...final thrust of thought.". Denis and Richter describe the learning processes which they identified from various sources as part of the activities central to intuitive learning. In their deliberation, they used the illustration of Isaac Newton (the English mathematician and physicist 1642-1727) who suddenly understood motion to become the person to formulate the law of gravitation, expressing it in mathematical terms. The World Book Encyclopedia (N-O volume 14 1981:306) provided the following story about Newton.

Newton said the concept of a universal force came to him while he was drinking tea in the garden and saw an apple fall. He suddenly realised that one and the same force pulls the apple to earth and keeps the moon in its orbit.

Newton illustrates a single act to realise something.

Denis, in conversation with Richter, also explained that:

Isaac Newton's famous insight about gravity came about after a lot of thought and study had taken place before his encounter with the apple. The apple falling was like the final thrust for his thoughts. (Denis and Richter 1988:31)

Newton did not need the apple to fall, but, this is seen as the trigger, a singular stimulus to make the connection and seen here to be a specific barrier overcome.

Learning breakthrough here is a single distinguishable learning event which is perceived as overcoming a specific learning barrier preventing learners' progress.

Cognitive

By 'Cognitive' it is meant here an internal step in the learning process(es).

Gagne (1985:48) is used as a framework to identify a learning strategy - a particular internal step. He, apart from other researchers, was chosen because he explains cognitivity in terms of a 'cognitive strategy' to describe thinking processes which manage learning. Cognitive strategies are, Gagne says "...learned skills that manage our learning, remembering, and thinking...". It was reference to the properties of cognitive strategies which

drew the researcher to use this writer to explain the curious way the learners internally, out of view to an observer of learning, overcame learning barriers. These properties are identified here as managing and manipulating processes or are an internal process of our thinking. What appears to occur is an internal process where the learner learns to manipulate information to produce a desired outcome - perhaps the outcome is an intellectual skill. However this would have to be further examined from the literature on learning breakthrough and later in the study.

Ernest (1987:10), discussing what he interpreted from observing students who experience learning breakthrough, infers that "...some internal process leads to insight". Here, a writer is seen to distinguish stages in the learning breakthrough experience, that is, there was some inner process and then understanding or insight suggesting to the researcher that the internal process was a step or a strategy learnt or used in a new way before the product, insight.

Niensted (1970:10), identifies various steps in one example of a new processing method which is acquired to increase a pupil's ability to analyse, evaluate and organise ideas. She apparently interpreted the steps below from process methods used by students she had observed - students in general and those experiencing learning breakthroughs. She notes that the increase occurs when the pupil first:

- 1 produces sounds to match printed symbols;
- 2 blends sounds into words;
- 3 associates printed symbols for words with the spoken word;
- 4 produces sub-vocal sound in response to printed symbols;
- 5 associates printed words with the concepts for which they stand;
- 6 groups printed words into meaningful phrases;
- 7 groups printed words into sub-vocal meaningful phrases;
- 8 associates printed sentences with complete thoughts;
- 9 comprehends unvocalized thought units; and
- 10 analyses, evaluates, organises ideas gained from the printed page.

There is a number of internal steps seen in the above list, but the focus here is on the possible cognitive process where the learner learns or manipulates their thoughts in a new way to produce a learning outcome. The point is that learning breakthrough contains a cognitive feature. From the above example of any one possible internal step (steps three, five, nine or eight), there can conceivably be a cognitive strategy, (repeated), or an information process, (encoding information), but what is important here is probable evidence of a cognitive strategy being learnt or used in a new way

to say that the strategy is a learning outcome. Taking an example from the above steps as a hypothetical case: “(the learner) analyses, evaluates, organises ideas gained from the printed page.”, (step ten), after the learner first “comprehends unvocalized thought units”, (step nine). The innate cognitive strategy of comprehension brought to the experience, is presumed to be used in a new way to manipulate ideas at the instance of learning to demonstrate step ten, that is, produce an insight to analysing, evaluating and organising ideas. To make the point, this comprehension cognitive strategy is presumed a learning outcome and an internally directed step in the thinking process of the learner.

Clement (1988:56), too, suggests that “...a breakthrough is a process that produces a key idea.”. What process is not definite. Gagne (1985:143) in discussing cognitive strategies in problem solving conveys similar thoughts. He maintains that:

...it is not at all clear at the present time that these strategies can be named appropriately or that the investigator can control the problem situation sufficiently to know which strategies are being engaged by the learner.

For the researcher to become more acquainted with his own experience and cognitive processes that other researchers are seen to suggest during the instant of learning breakthrough, two types of reporting the occurrence will be used: (1) people who themselves report learning breakthrough experience, and (2) researchers reporting others experiencing the phenomenon.

Firstly, from the people who report their own experience.

CASE ONE: Astrophysics.

Case one is from Roger Penrose who is Rouse Ball Professor of Mathematics at the University of Oxford. Penrose's (1991:543-4) explains the instant of learning breakthrough by writing that “...an idea occurred to me...”; and goes on to write that “...a thought which had momentarily elated me by providing the solution to the problem...”. Penrose describes a cognitive process which was internally directed managing his thoughts. There is no evidence of any externally directed outcome. It was all internally experienced and the learning was an internal learning outcome, such as a cognitive strategy.

CASE TWO: non-Euclidean Geometry.

Henri Poincaré, when realising that “...transformations used to define the Fuchsian functions were identical with those of non-Euclidean geometry”, created an idea explained by Penrose, who wrote about it, as a “...consciousness, fully formed...” (Penrose 1991:541-2). As possible evidence for such special processes, Poincaré perhaps manipulated concepts and his learning breakthrough was a cognitive strategy.

CASE THREE: Researcher’s computer programming.

The literature provides some evidence of cognition occurring at the moment of learning breakthrough, but, there remains uncertainty as to the actual strategy used or as Gagne (1985) suggests whether a type can be identified. As a test of whether cognitive processes are able to be identified, the researcher critically examined his own experience of learning breakthrough. This exercise is aimed at helping to understand further what the literature is inferring about cognition.

In reflection, the researcher initially clarified the information before progressing it to re-conceptualise his thinking. He reports that he was continually trying different program routines until the ‘penny dropped’. Generally, he perceives three things happening in sequence:

- 1 To begin with, the researcher was willing to adapt to new technology, an attitudinal aspect to the experience.
- 2 Part of the learning process was selecting appropriate information and skill to apply to the situation. As a further explanation (Gagne 1985:138) writing about cognitive strategies explains that selection processes are “...the skills to decide when and how to apply (information and skill) in attempting to solve the problem.”.
- 3 The experience is then perceived as a cognitive process to deduce from trying different routines that the characters being typed were translated in the computer as electronic messages coded from English letters. However, there was a single act of making an association with or between his knowledge about the concepts in common, that is, concepts such as electronic messages, and English letters. The newly acquired association of concepts (deduction) was internally directed in his thoughts, and a cognitive strategy.

A cognitive process is seen to occur in the researcher’s perception of his own experience of learning breakthrough as deduction.

Secondly, from the people who report others experiencing the phenomenon.

CASE FOUR: Scientist understanding the function of metal springs.

Clement (1988), in his study of creative thinking, recorded a scientist from another field thinking aloud while solving a problem he had with torsion and bending forces in metal springs. During the activity the scientist happened to experience a learning breakthrough. Clement (1988:53) describes part of that experience chosen here because it focuses on cognition. He writes: "...as the (scientist) was examining adjacent sides in the newly constructed hexagonal coil model, an existing mental schema for dealing with twisting situations was activated." and to illustrate the scientist's structural change in thinking Clement (1988:48) writes: "This can be considered to be a reorganisation in the first sense that a new system of relationships was created.". Apparently there was a new cognitive strategy learnt for the scientist to manipulate an existing mental schema in a new way and internally experience a learning outcome of reorganising data, which Clement (1988:51) goes on to explain as "...extraordinary reasoning processes."

CASE FIVE: Isaac Newton's insight about gravity.

When Isaac Newton equated falling to what he already knew of gravity forces to experience what the researcher would deem a learning breakthrough, Newton, through a cognitive process, made meaning of his knowledge (Denis and Richter 1988:31). Arguably, he was drawn to some missing link in his understanding of gravity forces when the apple fell. As a hypothetical explanation of Newton's learning process, consider the following steps.

1. He observed an apple move from a tree to the ground - the trigger.
2. Holding the vision, he was reminded of some prior knowledge - processes he brought to the learning breakthrough situation.
3. While he began to reason why, he made a connection - the breakthrough.
4. He assimilated what he connected to produce a credible explanation for what goes up must come down - the idea which formed was a result or the impact of learning breakthrough.
5. He later reinforced his idea progressing to the next step of appropriating the knowledge and skill to formulate his theory - the transformation.

Step three is the focus. Between the vision (step two) and the assimilation (step four) was a cognitive process where a new reason was created for explaining the vision and his prior knowledge. The point is the illustration of the use of a cognitive strategy(ies) in a new way for manipulating his learning, remembering, and thinking.

In summary, what emerges from exploring the feature of 'cognitive' are apparent examples of cognition from each experience of learning breakthrough reported in the literature and the researcher himself. In addition, other notable issues are also raised, namely:

1. that observation and self-reporting were used to identify cognition and that the latter method of inquiry provides more detail.
2. that the cognitive step is seen as an internal step which occurs at the instant of learning breakthrough - or as the learning breakthrough.
3. that there are three aspects of learning breakthrough: prior knowledge brought to the event, the event itself as a cognitive step and the results of the event which impact on the learner. The focus here is on the cognitive step.
4. that the quality to emerge is an internally directed process.
5. that the literature is seen to provide evidence of writers who suspect that cognition is present in what ever form.
6. that this study will need to investigate further the existence of cognition.

A central learning breakthrough step seemed to occur unexpectedly which is the next feature to be explored in the literature.

Unexpected

The unexpected feature of learning breakthrough identifies it as an unforeseen and unpredictable occurrence. No learner in the cases noted had anticipated the experience of having a learning breakthrough.

The literature helps the researcher understand how learning breakthrough unexpectedly manifests itself in many ways not just according to his own experience. The unexpected quality of the learning breakthrough experience is evident in many aspects of the learning breakthrough phenomenon, for example: environmental factors, situations, persons present or the learner's disposition at the time. It is noted that in

the great variety of situations, persons and so on learning breakthrough is unpredictable and manifests itself anywhere and at anytime.

The review of literature is here reported under the following headings. These reports are drawn out and summarised in Table 2.1.

SOCIAL ROLE	the primary societal engagement of the learner at the time of their learning breakthrough.
WHO	other important features of the learner, such as age and reason for involvement in education.
WHERE	the location of the learning event.
WHEN	the time of the day or the personal circumstances of the learning breakthrough.
WHAT	the subject or topic being learnt.

The headings refer to the following issues.

SOCIAL ROLE

- Niensted (1970:4) writes about her literacy students who experienced learning breakthrough. The social role of the learners at the time of learning breakthrough was student.
- Ernest (1987:10) also writes about students.
- Kawada and Johnson (1993) were accountants dealing with economic matters when a learning breakthrough occurred.
- Clement (1988:34) was writing about a scientist. The scientist's role at the time was researcher.
- Penrose and Poincaré were both adult academics and scientists (Penrose 1991:542-3).
- Halmos was a university student - age fifteen. Albers and Alexanderson's (1984:113) reported an interview with Paul Halmos whose breakthrough occurred unexpectedly while he was in conversation with a friend. Halmos was a well respected mathematician and Distinguished Professor of Mathematics at

Indiana University and Editor of the *American Mathematical Monthly*.

WHO

- Niensted's students were children who are seen as having a functional reading disability, but with a motivation to learn.
- Ernest's students were adolescents who enjoyed learning about computers.
- Kawada and Johnson were themselves adults and highly motivated business people.
- Clement's scientist was an adult who worked in a theoretical capacity and, during breakthrough, was engrossed in his interest in metal springs.
- Penrose (1991) writes about himself and another adult academic who worked in a theoretical context specialising in different fields of mathematics.
- Halmos was an adolescent student at the time of his learning breakthrough whose interest was mathematics.

WHERE

The 'where' concerns the situations in which each individual experienced learning breakthrough. Learning situations in Jarvis's (1987:150-7) definition are:

individual (that is., casual independent learning, 'soak up' the atmosphere, stubbing the toes, gardening, interaction with someone on a street corner)

informal (that is., social interaction, on-the-job learning to use a machine, clubs learning to play bridge, associations learning to become a treasurer)

non-formal "...in any organised, systematic, educational activity carried on outside the framework of the formal system. (p.155)" (that is., seminars gaining professional knowledge, workshops learning a skill, conferences learning to be aware of professional conduct)

formal (that is., in the formal educational system, school gaining basic knowledge and skill, college or university situations learning a profession and gaining a qualification)

This schema is used by the researcher as a framework to describe the learning situations and context of where breakthrough occurred.

- Niensted's students experienced their learning breakthrough in a formal situation, reported as a remedial class where she taught each student one-on-one.
- Ernest reports a similar formal situation.
- Kawada and Johnson were on-the-job and in an informal situation.
- Clement reports a non-formal situation with his scientist working in a science laboratory.
- Penrose describes casual situations to be seen in terms of Jarvis's schema as individual situations. Penrose was crossing the street and in conversation with an acquaintance. Poincaré was boarding a bus.
- Halmos reports an individual situation in a classroom. He was engaged in a casual conversation with a friend.

WHEN

- Niensted reports the incident occurring during class time. She (1970:4) observed learning breakthrough with her literacy students, where instant improvement in reading performance was unexpected and surprised both her and the students when it occurred.
- Ernest reports the incident occurring during classes while students were involved in problem solving activities. Ernest (1987:10) writes about the observations of students. He relates to "...flashes of understanding during their mathematics learning" at a time when understanding seemed far from the case.

- Kawada and Johnson were at the office, on-the-job, and while discussing experiments with new accounting techniques experienced a breakthrough with new ideas.
- Clement reports the scientist experimenting and during a time of concentration, though expecting a solution he was not expecting a breakthrough (Clement 1988:30-34).
- Penrose and Poincaré were unsuspecting because they were each engaged in casual conversations concerning matters other than the subject involved in their breakthroughs. For the reader, Penrose and Poincaré's breakthroughs occurred as they relaxed in learning situations unconnected with their discovery and are as follows.

Penrose himself was affected by a feeling providing only a clue to an impending idea, (the learning breakthrough), which cut across his thoughts at the time. Penrose had no pre-warning of what was to happen being in a relaxed situation and casually talking with a colleague while crossing a street. The occurrence could have happened anywhere and at any time.

As Penrose reports, Poincaré was boarding a bus. One striking aspect of Henri Poincaré's experience was that the "...complicated and profound idea apparently came to Poincaré in a flash while his conscious thoughts seemed to be quite elsewhere." (Penrose 1990:542). Poincaré's case shows he was not expecting a breakthrough while concentrating on other matters.

- Halmos was talking to a friend after a lecture and, similarly to Penrose and Poincaré, he was in a casual conversation when an absurd piece of reasoning, (to Halmos at the time), suddenly had meaning. He understood "epsilon" to his surprise at a moment when he, in an otherwise empty classroom, experienced a learning breakthrough.

WHAT

- Niensted reports as the subject, basic principles of reading.
- Ernest reports mathematics using computers as learning aids.
- Kawada and Johnson were apparently involved in strategic management accounting.

- Clement's scientist's subject was bending and torsion forces in metal coil springs.
- Penrose, Poincaré and Halmos were involved in mathematics.

Learning breakthrough potentially does not discriminate with people or moments or subjects or places as the literature indicates. It is an unexpected occurrence with children, adolescents or adults. The occurrence was evident with basic learners academics, scientists, people learning on-the-job and off-the-job. There seemed to be no limitation to the place nor timing of learning breakthrough experience and subjects seemed to have no direct influence on its occurrence. Learning breakthrough can occur with anyone, at any time, anywhere and with any subject - and is thus unexpected and unpredictable.

For convenience, the following Table 2.1 provides a way of summarising the many dimensions of the unexpected feature of learning breakthrough.

Table 2.1 Who, Where, When and What involved in Learning Breakthrough Occurrence

(Table 2.1 is a representation of the variety of situations found in the literature about learning breakthrough)

SOURCE	SOCIAL ROLE	WHO Type Of Person	WHERE Situations	WHEN Timing	WHAT Subject
NIENSTED (1970)	School students	Children who were seen as reading disabled with a motivation to learn.	Remedial class (Formal Situation)	Class time during one-on-one instruction	Basic principles of reading
ERNIST (1987)	School students	Adolescents who enjoyed using computers.	Classroom (Formal Situation)	Class time during problem solving exercises	Mathematics using computers as aids
KAWADA AND JOHNSON (1993)	Accountants	Adults who are highly motivated business people.	On-the-job (Informal Situation)	Duty time during an experiment with new accounting systems	Strategic Management Accounting
CLEMENT (1988)	Scientist	Adult, theoretical thinker.	Scientific laboratory (non-formal Situation)	Duty time during a self experimental case study	Bending and Torsion forces in metal coil springs
PENROSE (1991)	Academics	Adult intellectual people who were not consciously involved in the subject at the time.	Casual situations (Individual Situations)	One person was entering a bus and the other was crossing a road during relaxed moments	Mathematics
ALBERS AND ALEXANDERSON (1984)	University student.	Adolescent, motivated to learn.	Lecture room (Individual Situation)	After class time during a conversation.	Mathematics

What is evident is that learners may anticipate outcomes for their efforts because that was what they desired, but a breakthrough was always unexpected when it occurred. The learners either did not predict the timing, place or the extent to which learning breakthrough would impact on them.

The literature indicates that learning breakthrough is consistently unpredictable or unexpected. The phenomenon can occur in any situation, involve all sorts of people doing all kinds of activities and subjects, its timing is unforeseen and it is a surprise to the individuals involved. There is no evidence to suggest that because conditions are right and key factors are present, learning breakthrough is guaranteed to happen.

Instantaneous

Learning breakthrough was reported as happening suddenly and without warning. By 'Instantaneous' is meant this momentary quality.

Niensted (1970:4), referring to her students, writes of the incident "...which altered their reading attack so that there was instantaneous improvement.". She perceived that only a fleeting moment passed between the problem and the desired outcome.

Ernest (1987:10), describes the experiences of his students as "...flashes of understanding...".

Penrose (1991:541-4) wrote of Poincaré that "...at the moment I put my foot on the step (of the bus), the idea came to me.". Of himself he wrote "...a thought which had momentarily elated me by providing the solution to the problem.". The learning breakthrough came in the form of an idea, a mere thought which momentarily elated Penrose. The thought was as sudden as it was unexpected because Penrose's main thoughts at the time were on other matters.

Rock and Palmer (1990:60) writing generally explain an 'Aha! experience' as a learner suddenly "seeing" a solution to highlight their perception of the speed of breakthrough. They wrote:

When people let go of implicit assumptions, their understanding of a problem is sometimes dramatically reorganised, enabling them suddenly to "see" the solution, complete with the accompanying "Aha!" experience.

Psychologists also report the suddenness of breaks with mental fixations - barriers in the researcher's terms. Scheerer (1963:154), who was a psychologist exploring the phenomenon of fixation with people trying to solve problems, explained the solution to the "9-dot problem" and the mental fixation which dogged the learner was resolved in an instant being seen as a "...sudden shift in the way the problem or objects involved in it are viewed...". Scheerer, a gestaltist, here refers to the instant visual perception which enabled the learner to solve the problem. The appearance of the vision during learning breakthrough was instant, not a prolonged step.

Clement (1988:57) describes the scientist's eureka experience as an "...extremely fast emergence of a new idea."

The scientist in Clement's case study talked through his Aha! experience as it was occurring. Clement's method for exploring his research subject was to have the participating scientist verbalise his thoughts. Clement (1988) writes, relating to the scientist's commentary at the time:

Let me just generate ideas about circularity. What could the circularity (in contrast to the rod) do? Why should it matter? How would it change the way the force is transmitted from increment to increment of the spring? Aha! Now let me think about; Aha! Now this is interesting. (Clement 1988:32)

The examples describe the manifestation of learning breakthrough, instantaneous in occurrence, to achieve a sudden understanding for the learner.

Transformation

One of the key features of the researcher's learning breakthrough was the way in which the skill to write programs became an ability that gave the researcher a totally new and improved approach to complete programming - a major personal change. Transformation here is defined as change brought about as a result of learning breakthrough and the quality explored is permanency.

Niensted (1970:6-9) reports on three students who gained lasting knowledge and skill to overcome their individual learning problems. Using quotations from Niensted, the following is a record of the transformations she observed.

First Student

In the following private lessons he needed no help in sounding out at least eighty percent of the words in seventh-grade texts. The reading was slow and deliberate. A few weeks later his mother, with tears in her eyes, reported that for the first time in his life he was willing to read in front of his sister who was years younger.

Second Student

She repeated the performance six times. She demonstrated a new skill to comprehend the theme of what she read.

Third Student

At the point of learning, he read two hundred fifty words a minute, announced, "It works," and proceeded to give total recapitulation of the passage.

After the learning, without my suggestion or knowledge, the boy and a friend timed each other over the weekend, and he reported rates of two hundred fifty to four hundred fifty words a minute depending on what he was reading. He continued to use a fast rate of reading, needing at times a reminder to adjust his rate to the material and always to read for comprehension.

Ernest's (1987:10-11) students show ability above themselves to assimilate new skills transforming their abilities demonstrated prior to learning breakthrough.

First Student

The teacher inquired; "You must have a rule, you got there so quick...". The girl replied: "Ye ar, I got there. 'ccs you add...' if it's like a 29 you double and take away one.... You do it by doubling the number what you put in, and then take away one.

In a magic moment these components gelled in a conjecture relating the number of rows to the number of unit triangles. In a moment of insight, Donna's mind leapt onto a higher plane, rising above the particular examples to a conjecture; the general relationship.

Second Student

The student is able to make new generalisations to solve more problems.... There was a new schema of thinking which is associated with the student (becoming a better achiever), higher level of thought process.

Transformation for Clement's (1988) scientist is confidence. Clement (1988:31-34) reports:

[Before the scientist's learning breakthrough] ...confidence in understanding of the situation was way down, zero.

Before this torsion insight,...I felt that I did not really understand what was happening; now my confidence in the answer is near 100% and my confidence in my understanding is like 80%

The report from Poincaré is that he "...felt a perfect certainty.". (Penrose 1991:541). Penrose too reported a change realised when he returned to his laboratory to find that what ever occurred during his conversation and street walk was not lost. He writes:

Then it did not take me long to form the outline of a proof of the theorem that I had been looking for.

Apparently, what he had gained at the learning breakthrough experience was not lost, there was a transforming influence upon his ability to understand and project that understanding in the form of a new theorem.

In conclusion, to explain the transformative dimensions of the learning taken place after breakthrough the researcher has chosen to refer to Mezirow (1991:171) because his work particularly explores the transforming dimensions of learning. He writes that "...transformation may be explained by the learner acquiring an insight that results in a transformation in meaning scheme that may contribute over time toward a change in meaning perspective...". Each individual reported in the literature experienced a change and the transformation is seen here in the way they moved from the learning breakthrough situation to manage life's novel challenges with the knowledge and skills appropriated from the experience.

Pleasurable

Pleasurable is a feature which relates to the emotions aroused because of learning breakthrough experience. In all the reports explored, learning breakthrough was described as joyful and satisfying. This is not to say that unpleasant feelings and emotion can not occur before or during learning breakthrough. A person could have a breakthrough which made clear a frightening or unpleasant situation. However, the reports have been of experiences associated with satisfaction and pleasure . In summary, the pleasurable experience is noted as follows.

RESEARCHER

- The researcher remembers wanting to shout something. Maybe it was Aha! experience or eureka expressing the notion of excitement, the intention was to express his joy in attaining a level of understanding he thought was beyond his talents. It was seen also in the literature how learners used similar expressions with an intonation of joy.

CLEMENT (1988)

- Clement's (1988:27-8) scientist used the word Aha! to express how he felt.

Aha! Now let me see...Aha! Now this is interesting...and my confidence is now 99%...I now feel pretty good about my understanding...

NIENSTED (1970)

- Student one expressed his joy with a smile.

...he sucked in his breath, and ejaculated the word, "why!" not as a question but as an expression of surprise. He turned to me, smiled... (p.6)

- Student two showed a sense of satisfaction.

I pronounced only the words, "What about..." when the girl interrupted, "Oh I get it.". She immediately gave the complete thought expressed in the sentence. (p.7)

- Student three also showed a sense of satisfaction.

He read two hundred fifty words a minute, announced, "It works." and proceeded to give total recapitulation of the passage.

ERNEST (1987)

- Ernest's students expressed their joy as Aha!. Ernest used the word "magic", as meaning something exceptionally exciting. He writes:

...is that magic moment, the Aha! experience.

..."Aha!..." "I see..." as they make a mental leap.

PENROSE (1991)

- Penrose described his breakthrough experience as "...an odd feeling of elation.". (p.544)
- Without any description of joy one could presume from Poincaré's comment "...felt a perfect certainty." that learning breakthrough did not displease him. (p.543)

ALBERS AND ALEXANDERSON (1984:123)

- Halmos, too, felt some form of joy having been inspired to realise his ambition.

Each account emphasises some form of positive emotional feeling, whether joy, satisfaction, confidence or excitement. These feelings illustrate the affective dimension of the learning breakthrough experience.

It is argued that the emotional factor associated with learning breakthrough may contribute to the learners' remembering their experience. Such a proposition is explored in the following feature from the literature on learning breakthrough.

Memorable

By 'Memorable' is meant that learning breakthrough is able to be remembered both in the short term and over time. This section explores the learners' ability to remember detail about learning breakthrough.

The approach here is to explore learners who themselves report their learning breakthrough because from reflecting, they, rather than an observer, provide experiential knowledge which is desired.

Halmos' learning breakthrough occurred forty years earlier. His account of events was recalled through an interview with Albers and Alexanderson's (1984:123). He remembered even small details of the event with clarity.

In part, Halmos's words to answer Albers' question; "Was there some point when you decided that you were going to be a mathematician?", he replied:

...then one afternoon something happened. I remember standing at the blackboard in Room 213 of the mathematics building talking with Warren Ambrose and suddenly I understood epsilons. I understood what limits were, and all of the stuff that people had been drilling into me became clear. I sat down that afternoon with the calculus textbook by Granville, Smill, and Longley. All of that stuff that previously had not made any sense became obvious; I could prove theorems.

Remembering such a starting event was understandable, but, more remarkable was the detail in which he remembered after forty years, for example, the room number, the name of the person present, where he was standing at the time, the surroundings (blackboard), what his actions were after breakthrough, the name of the authors whose book he referred to and what the event meant to him as a career change.

Poincaré's learning breakthrough was interrupted, illustrating the exceptional way people can remember such events. During his learning breakthrough, being in a bus, and distracted immediately through a conversation with the person sitting next to him, he had every opportunity to forget experiencing a breakthrough, particularly when his thoughts and interest at the time were elsewhere. He did not forget. Penrose (1991:541) records Poincaré as saying "...I felt a perfect certainty...". He was referring to his emotional response of having discovered, at that moment, the solution to his theorem. He remembered a fleeting moment of learning breakthrough recalling the occasion later to solve his problem and, in addition, recalling the experience to report it to Penrose.

Penrose (1991) also had every opportunity to forget, but he remembered the time, place, the person with whom he was crossing the street, the elation at the moment of breakthrough and so on. He remembered details of his surroundings and of course the thoughts which inspired him. Penrose's account of the situation is as follows.

Evidently, during those few moments, an idea occurred to me, but then the ensuing conversation blotted it from my mind. Later in the day, after my colleague had left, I returned to my office. I remember having an odd feeling of elation that I could not account for. I began going through in my mind all the various things that had happened to me during the day, in an attempt to find what it was that had caused this elation. After eliminating numerous inadequate possibilities, I finally brought to mind the thought that I had while crossing the street. (p.543-4)

The quality, that these reports of remembering provide, is seen as learning breakthrough being significant because it is an event where people can isolate original learning for later critical reflection.

The fact, from the cases in the literature that learning breakthrough experiences can be remembered often in vivid detail long after the event, provides the researcher with support for exploring learning breakthrough with adult learners reporting their own experiences.

Summary to Features of Learning Breakthrough

The features of learning breakthrough showed the researcher that his experience may have qualities in common with other experiences from the literature: (a) it was a single incident overcoming a specific learning barrier, (b) that in each case there was a cognitive process, (c) learning breakthrough was unexpected, (d) it was instantaneous, (e) it was a transforming learning experience, (f) it was enjoyable and (g) it was memorable.

What the literature indicates is that this study now has a basis for a structure because three aspects became clarified from the issues brought out in the broader experience of learning breakthrough.

1. Context

Learning breakthrough happens to anyone, anywhere, at anytime and with any subject.

2. Type of Learning

Learning breakthrough is learning outcome based and was conceived by the researcher to refer to cognitive processes, intellectual skills, motor, and communicative skills as people grappled with tasks, subjects, and topics.

3. Experience itself.

Learning breakthrough is an engaging experience, instantaneous in nature and occurring unexpectedly. The experience is seen as being enjoyable and can be remembered as a notable experience.

There was evidence to show the researcher that learning breakthrough is a transforming experience within the knowledge, skill and attitude of the learner.

As a result of the literature search, two aspects of data collection methods related to learning breakthrough research were clarified: (1) in the work reviewed, observation and experimentation were the predominant methods used to describe learning phenomena; and (2) self reporting of learning breakthrough experiences would provide an alternative, and appropriate, method.

CONCLUSION

There was minimal evidence of learning breakthrough recorded in the available literature.

The literature reviewed on learning breakthrough has explored and established 'learning breakthrough' as a term for appropriately describing this phenomenon of learning to distinguish what learning breakthrough is and what it is not. It is not, for example, creative thinking or intuitive learning. Learning breakthrough is not just linked to memory, as it is a more complex process of events. It is not insight because the literature shows the researcher that insights occur after learning breakthrough.

From the researcher's perception of the phenomenon reported in the literature, the relationship between his nine characteristics of learning breakthrough and the features seen to emerge from the cases in the literature are:

<u>FEATURES</u>	<u>RESEARCHER'S CHARACTERISTICS</u>
Singular	In retrospect, yes
Cognitive	An Internal Process
Unexpected	Unexpected
Instantaneous	Sudden
Transformative	New understanding Change process Transformation
Pleasurable	Excitement
Memorable	Evidently so

The researcher's initially identified properties of learning breakthrough being extraordinary and barrier breaking are seen here as being presupposed in the literature by the very notion of learning breakthrough.

The general field of study is adult learning because the writers whose work helped describe aspects of the features of learning breakthrough are adult learning educators - Jarvis (1987), Mezirow (1991), and Gagne (1985). In addition, from the literature it is seen that in the main adults were reported.

Finally, the literature reviewed in this Chapter contributed toward the development of a conceptual framework of three areas which provided a way of describing learning breakthrough. The framework categorises the breakthrough experience into three concepts, the context in which the event(s) occur, the types of learning involved and the experience of the change for the learner. The next chapter describes the development of the conceptual framework.

CHAPTER 3

THE CONCEPTUAL FRAMEWORK

INTRODUCTION

The Conceptual Framework is a structure designed to describe learning breakthrough - provide a means for analysing the data collected. This chapter explains the development of the conceptual framework.

There are three aspects of the learning breakthrough experience which give structure to the framework: (a) the context of learning breakthrough, (b) the type of learning evident in learning breakthrough, and (c) the learner's experience of learning breakthrough. The three aspects are created from the review of literature in Chapter two and other literature concerned with adult learning, and is informed by the researcher's understanding of his own learning breakthrough experience.

In summary, the three aspects of the conceptual framework for describing learning breakthrough experience are:

- Context of Breakthrough,
- Types of Learning, and
- Experience of Breakthrough.

THE CONCEPTUAL FRAMEWORK

In developing a suitable conceptual framework, the researcher had to consider the need for a comprehensive structure in which to capture the complete experience of learning breakthrough extending to the areas before, during and after the learning breakthrough instant.

Learning breakthrough, is complex. Each of the three aspects are articulated through a selection of core component concepts which reflect that complexity.

These core component concepts, which will be explained in more detail later, are chosen to serve as a checklist for analysing data within each heading.

The first aspect, concerned with the context of breakthrough, contains six adult core components. They are: 'Environmental Factors', 'Learning Situation', 'Social Situation', 'Influence of Teachers', 'Learning Aids', and 'Characteristics of Adult Learners'.

These core concepts were identified from adult learning literature, particularly Clark (1987) who formulated a framework in which to describe the teaching-learning event. Clark's (1987) terms were adapted because he was exploring the teaching-learning event where the focus here is learning breakthrough. The terms that are an adaptation of Clark's (1987) elements are: 'Contextual Factors', 'Teaching Methods', 'Characteristics of the Facilitator', 'Characteristics of the Learner' and 'Teaching/Learning Theories'. The adaptation is, for example:

Clark (1987:38) uses the term 'Contextual factors'. As the broad heading here has the word 'context', a term using the same word would be confusing. The researcher chose a more direct term, 'Learning Situation';

The researcher adapted to include Clark's (1987:40) element 'Teaching Methods' as one part of the 'Influence of Teachers' because methods are seen in this study to relate to teachers. The other part of the 'Influence of Teachers' is the adaptation of Clark's 'Characteristics of the Facilitator' which describe pragmatic considerations about teachers and seen here to be adequately described by the use of the one term;

The 'Characteristics of Adult Learners' comes from an adaptation of Clark's (1987:38) term 'Characteristics of the Learner'. Generally both terms describe similar aspects. However, with the addition of the word 'adult' it provides a term seen here as being more focused on the type of learner participating in this study.

Clark (1987:39) uses the term 'Teaching/Learning Theories' which provides a way of considering the assumptions, concepts and principles behind everything teachers and learners do. The researcher has chosen to focus these matters pertaining to the person of the learner under the term 'Characteristics of the Adult Learner' and those matters pertaining to the teacher under the term 'Influence of Teacher'.

Three other terms in this framework have different sources. They are: Environmental Factors, Social Situation and Learning Aids. These are additional terms because the researcher found that with his own and other experiences of learning breakthrough; (a) locations and places can be an influence on learning, therefore, he chose the term 'Environmental Factors'; (b) as the researcher became aware from other casual conversations, where he inquired about other learning breakthrough

events, other people may or may not become involved in the learning process and chose 'Social Situation' as a mechanism for exploring this aspect; and (c) teaching and learning devices can be involved in the learning process and because such matters were not adequately described by Clark (1987), the term 'Learning Aids' was developed separately as described below.

Each of these terms provides a way for exploring different aspects of the phenomenon in relation to the environmental, social, physical, psychological, spiritual and moral circumstances which singularly or collectively made up the context of the experience of learning breakthrough before and during the experience.

The second aspect, 'Types of Learning', is developed in terms of Gagne's (1985) five learning varieties. The five terms describing types of learning by Gagne (1985) are: 'Motor Skills', 'Intellectual Skills', 'Attitudes', 'Verbal Information', and 'Cognitive Strategies'. To these are added one additional learning type to recognise the process of utterance or exchanging ideas and thoughts, namely 'Communicative Skills'. This type was chosen by the researcher from work by Habermas (1991) essentially, and Mezirow (1991) and Gagne (1985) for variations of communicative skills, explained later. The analysis in this study benefits from the distinction between various discrete learning types by being able to identify the potential range of core component concepts involved in learning breakthrough.

The third aspect, 'Experience of Breakthrough', particularly addresses how the learners experienced learning breakthrough. Identified here are four categories of experience. Firstly, the experience or activity of moving towards the learning outcome - learning breakthrough. As a choice of a core component concept, Gagne's (1985) model for the flow of information is adopted, namely 'Information processing'. Secondly, the learning is seen to occur in a learning engagement. Part of that engagement is the experience of it as reported by each individual participant. The term chosen by the researcher to represent the engagement is 'Encounter'. By 'Encounter' is meant how the learner experienced learning breakthrough, that is for example, it was experienced suddenly. Thirdly, the learning breakthrough is represented by what results from the experience, and as a core concept, the researcher has chosen the term 'Impact' to describe the immediate effect of learning breakthrough. Finally the researcher wants to describe the change within the learner themselves.

For this purpose, the choice of term is 'Transformation'. This term is borrowed from Mezirow (1991) who explores the transformative dimensions of adult learning.

The aspect of the experience of breakthrough, then, examines four key core component concepts and uses as terms to describe them: 'Information processing', 'Encounter', 'Impact' and 'Transformation'.

Context of Breakthrough

The context of breakthrough refers to the conditions and circumstances that are relevant to learning breakthrough before and during the event. 'Context of Breakthrough' is developed by examining each of the six concepts associated with the context.

The **Environmental Factors** are distinguished by non-human aspects of the surrounding physical features such as furniture. The environment for learning breakthrough may vary considerably, with different situations for different people requiring different descriptors for different settings. These factors help to identify where people learn, for example, libraries, in the home, schools and so on. These latter variations in the environment are examples of descriptors mentioned previously. The literature providing the information on environmental factors deals with the settings where adults learn (Jarvis 1987), the provision of learning environments for adult education (Jarvis 1988), and agencies through which adults are educated (Darkenwald and Merriam 1982).

The **Learning Situation** identifies the type of activity in which the learners experienced their learning breakthrough. For example, some variations may be an involvement in an academic or a manual activity, on-the-job rather than in some formal organised study program, or learning through library or museum research. These variations and the atmosphere they inject into the learning situation are described through this adult learning term. The literature provides examples of various situations for learning thus helping to describe the locations of the learning activities in which the adults in this study were engaged. In the literature, Jarvis (1987) describes adult learning in the social context to provide instances where adult learners become involved in education formally, non-formally, individually and so on; Clark and Rooth (1988) discussed the range and

diversity of adult education programs; Brennan (1990) provides instances of how and where professional people become involved in learning situations, for example, through subscription to magazines; and Titmus (1989) examined the avenues through which adults sought education.

The **Social Situation** relates to the degree of involvement of other people. This adult learning term differs from 'Environmental Factors' which identifies physical items or buildings. 'Social Situations' describes whether the learner was alone or with people. In addition, where as the learning situation concerns the programs and places of learning, the social situation concerns people.

The literature consulted provides information for choosing various alternate social situations where adults learn. Clark and Rooth (1988) provide case stories and report the involvement of people. Dick (1991) provides examples of action learning programs and describes the involvement of people in groups or as an individual activity.

The **Influence of Teachers** is chosen to describe how teachers assisted or provided difficulties for the learners who report experiencing learning breakthrough. Where a teacher, tutor or coach was involved it may be said that they had an intention to influence the learner, that is, sometimes with the right intention, sometimes with the wrong intention. Sometimes learning may occur in spite of the teacher, tutor or coach and a term was needed to illustrate these issues. The teacher, in the researcher's case, appeared to actively promote individual effort which contributed to the researcher not giving in when he was confronted with, the then expected, insurmountable problems. His teacher had the right intentions to influence the researcher in a positive way. To differentiate from the terms already discussed, 'Influence of Teachers' describes intentional intervention by other people with a teaching function who are in the learning situation. 'Environmental Factors', in comparison, describes the non-human static or demographic context, and 'Social Situation' describes the human presence and 'Influence of Teacher' describes the effects the teacher's presence had on the learner. These factors are illustrated in the literature as follows.

One area of adult education literature, concerning teacher influence, shows how the teacher can select a method which best suits a learner (Dick 1991, and Clark 1987).

Other writers focus on intervention based on the views or ideals held by teachers (Knowles 1990, Elias and Merriam 1980, and Clark 1987). Bagnall (1990) expresses the view that teachers are demonstrators of good practice to influence the learner to do the same. Cross (1981) addresses issues related to the implications of teaching/learning practices. Gagne (1985) discusses the conditions for learning. Knox (1986) provides a range of techniques used by teachers to help adults learn and Wlodkowski (1985) contributes with strategies to motivate a learner.

Another key concept is **Learning Aids** needed to describe learning tools because tools, for example, computers, handouts and overhead projected transparencies were involved in the researchers' learning breakthrough and presumed present in other learning breakthrough experiences. In dividing adult education processes into three groups, Verner (1964:35) provided a way for the researcher to identify a relationship with learning aids. Verner (1964:35) writes as follows:

There are three basic components inherent in the establishment of (a relationship for learning between an educational agent and a learner): organising people for learning, helping the participant to learn, and selecting from the multitude of devices available those which will be employed to facilitate the operation of the first two. These three components are identified as methods, techniques, and devices.

It is here, under this term, that the researcher has chosen to describe devices where they alone exert an influence on the learner. Other literature provides some guidance for choosing appropriate examples of aids for learning (Dick 1991, and Jarvis 1988), Clark (1987) discusses the importance of such items in the teaching/learning transaction, and Gagne (1985) and Tough (1979) identify intervention other than that directly from the teacher.

The **characteristics of adult learners** is the final term identified in the context of breakthrough. The term applies to qualities which the learner has brought to the learning situation and used to describe the context in which they had themselves been developed as adult learners. The key concept here describes, for example, the psychological factors. These can be age, ambition, motivation, confidence, disposition, values, habits and beliefs which influence the learner favourably or adversely before or during their learning breakthrough experience. Age also relates to and describes the physiology and related strength of the learner, particularly where gross motor skills are concerned.

Knowles (1990:24 and 40) identifies personal percepts of self and the world impeding on a learner, a symptom which may mean a fixation causing the learner to view a subject with a false perception. Knowles (1990) and other writers such as Houle (1963) who characterised various orientations in which adults were motivated to learn and explained major conceptions adults hold about their learning activity, and Jarvis (1988) who contributed with the nature of the individual, provide information by which to describe characteristics peculiar to each participating learner in this study.

Various writers help by noting characteristics which they claim are consistent with adult learners. On noting the characteristics, the researcher is able to describe internal circumstances influencing the learners at learning breakthrough. In addition to the above writers, literature helping to identify further adult learner characteristics dealt with the characteristics of the learner in particular their psychological and physiological needs (Clark 1987), motivation (Wlodkowski 1985), personal variables (Long 1983), learner development (Brundage and Mackeracher 1980), adult learning principles (Brundage and Mackeracher 1980), characteristics of adults (Apps 1979), self-concept, readiness to learn (Knowles 1990), activities and actions of adult learners (Mezirow 1991, and Jarvis 1987:61), and Merriam and Caffarella (1991) for examining the distinguishing characteristics of the adult learner, in particular behavioural factors.

The 'Context of Breakthrough' provides a guide to what constitutes the context in which this study's reported learning breakthrough experiences have occurred. The next consideration is 'Types of Learning' for examining what was learnt and used in the breakthrough process. This aspect relates to human capabilities which are key core component concepts with the potential for exploring all learning types evident in the reported learning breakthrough experience.

Types of Learning

Potentially, individual learning breakthrough experience may involve a wide variety of learning types as seen in the foregoing explanation: Motor Skill, Communicative skills, Intellectual Skill, Attitudes, Verbal Information, and Cognitive Strategies.

These learning types or key core component concepts are terms borrowed from Gagne (1985) and Habermas (1991). Using these terms provide a means for describing the learning outcome(s) evident with the breakthrough experiences reported in this study.

Motor Skills are identified as manual manipulative skills or skills for executing movement. For example in this study, they can be demonstrated by writing, cutting a piece of wood, swimming, discrete movement, striking the ark during welding, sound making and so on.

The term **Communicative Skills** represents learnt capabilities enabling a person to declare knowledge of names, facts and a wide collection of organised ideas (Gagne 1985:154). Capabilities here are communication skills of elaboration, pronunciation, expression, explaining and so on, and may be demonstrated by a learner through speech, writing, composing or non-verbal expression, (Habermas 1991:26-33, and Mezirow 1991:75). The term is used in the study to help describe what was learnt as processes to exchange thoughts during and after learning breakthrough.

Intellectual Skills are seen here as skills which the learner directs externally. The term provides a way to describe how the learner was able to perform the task, problem solve or use symbols. As cognitive strategies are perceived as learnt functions of thinking and processing, intellectual skills are making use of these strategies in order to perform through applying knowledge into life's situations. Variations of an intellectual skill are, in Gagne's (1985) hierarchy, adopted for this study: rules, defined concepts, concrete concepts, and, his lower order of learning, discrimination. Gagne (1985:178) separates, as problem solving, higher-order rules at the top of his hierarchy. In this study, preferring not to create another category, the researcher has chosen to include higher-order rules as part of the hierarchy of intellectual skills. The higher-order rules are included as an inseparable part of intellectual skills which are externally directed by the learners in this study. Each skill is further explained as follows.

HIGHER-ORDER RULES are, for Gagne (1985), the highest form of human learning used in problem solving situations. "Skills requiring the application of specific rule combinations."*. The higher-order rules create the rules from combinations of component rules to solve problems.

* The researcher wishes to recognise the unpublished work of Dr R. G. Bagnall who produced a summarised version of Gagne's (1985) hierarchy of intellectual skills. The reference is as follows. Bagnall, R. G. "Design and Development of Training Programs: Workshop on Learning Theory in Instructional Design". International Training Institute. Armidale, N.S.W. University of New England. (no date provided)

Gagne (1985:54) explains that: "In attempting to solve a particular problem, the learner may put together two or more rules from very different content domains in order to form a higher-order rule that solves the problem.". In the study, the term is used to identify instances where a rule is created in problem solving.

RULES, (or component rules), are seen as "...procedures for identifying relationships between two or more concepts."*. For example, "The simple rule 'birds fly' can be expanded to 'birds fly south in the winter,'" (Gagne 1985:125), which contains two and four concepts respectively. The intellectual skill which may be demonstrated is the rule for understanding the relationship between concepts. In the study, this term is used to identify instances where a rule is already established and the learner has applied the rule.

DEFINED CONCEPTS or classifying concepts which are, for example, "...being able to identify entity from a definition of the class."*. Gagne (1985:113) infers that a defined concept is an abstract form of definition not concrete. He writes: "One cannot identify instances of the class *cousins* on the basis of their appearance...". In the study, the term is used to identify instances of classifying abstract concepts.

CONCRETE CONCEPTS are "...demonstrable concepts... being able to identify instances of 'green-colored objects'."*. Gagne (1985:109) explains that concrete concepts are "...expressions from the domination of the physical environment.". Concrete concepts are tangible where defined concepts, in comparison, are intangible, not observable objects or demonstrable facts. In the study, the term is used to identify the use of tangible concepts as identifying difference or analyse verbal information.

DISCRIMINATIONS come out of the observable world in which we live and requires "...distinguishing between items of perceptual information, (for example), being able to distinguish an 'x' from a 'y'."*. Discriminations are seen in making a choice or judgement between a simple set of objects or facts. Gagne (1985:92) infers that discriminations are discriminations among physical appearances. In the study, the term is used to identify instances of the applied use of the lower-order skills as in clarifying an association or distinguishing between facts.

Intellectual skills, for example, allow a person to solve mathematical problems, create formulas, follow a procedure, perform a manual physical task (sawing a piece of timber square across its face), apply a law, or use a routine to operate a machine. Gagne (1985:48) refers to intellectual skills as "procedural knowledge". For example, the researcher created a rule of language translation. He learnt to translate English words into computer machine code, a higher-order rule in terms of this study.

To describe views and values learnt, the researcher chose the term **Attitudes**. Attitudes, as Gagne (1985:48) writes, are mental states "...that influence the choices of personal actions."

For example, should a learner show allegiance to a particular belief then that person may respond by learning on the basis of that belief. An instance of this might be a Muslim person who believes that Jesus was a prophet, but, if he or she changes that belief and becomes a Christian believer then he or she would say that Jesus is God and go on to learn with that belief as a basis. The attitude learnt is a belief (or may be a religious value) dependent on the way a person perceives reality, but, the point is that the attitude would be carried to the next learning situation to determine the tendency of a person to respond in a certain way. With the term 'Attitudes', the researcher is able to describe preferences or moderators learnt such as dispositions, assumptions, allegiances or beliefs to help explain what attitudes were learnt as an outcome of learning breakthrough. The researcher himself learnt confidence which meant that he began to approach computers confidently.

The next two types of learning relate to internal processes. Where motor skills, communicative skills, intellectual skills are externally directed functions, 'Verbal Information' and 'Cognitive Strategies' are internally directed functions.

Verbal Information is language as a structure, chosen for the study as a way to describe acquired knowledge. Gagne (1985:154) writes, verbal information "...refers to information that is verbalisable.", for example, information as language, names labels, symbols and so on.

The **Cognitive Strategies** are acquired strategies for managing the way individuals think. Gagne (1985) makes the distinction between cognitive strategies and information processing describing cognitive strategies as being learnt and which regulate internal processes to select or retrieve information into or from memory. Gagne (1985:38) writes:

By acquiring and using (cognitive strategies), learners are able to regulate such internal processes as (1) attending and selective perceiving; (2) encoding incoming material for long-term storage; (3) retrieval; and (4) problem solving.

In comparison, where intellectual skills are directed externally cognitive strategies are internally directed by the learner. Cognitive strategies, to regulate the encoding of information, may be achieved by association, making comparisons, clarifying or discerning. Data described by this type of learning have to be particularly explored in an interview where initial reports failed to identify a strategy of thinking.

The researcher, for example, remembers learning to use association in a new way to make the connection between characters in words and computer switches. This term helps to describe the way other learners internally regulated learning.

Experience of Breakthrough

The third and final aspect of the conceptual framework is 'Experience of Breakthrough'. This part of the conceptual framework helps the researcher describe how the learner experienced learning breakthrough - to identify how the incident was engaged and what resulted.

Establishing the experience of breakthrough in the conceptual framework, Mezirow's (1991) work on the theory of transformative perspectives provided a way to explain what the researcher experienced. Mezirow (1991:4) identifies "...codes that govern the activities of perceiving, comprehending, and remembering.". The researcher sees as codes, key core component concepts of the experience: 'Information Processing' describing the process experiences moving towards the learning outcome, 'Encounter' describing the experience of the engagement with learning breakthrough, 'Impact' describing the effects of learning breakthrough and 'Transformation' describing personal change as a result of learning breakthrough, (this last being the learning outcome in Gagne's framework and 'types of learning' in this conceptual framework).

Information Processing may be analysed through a single act of learning as identified from Gagne's (1995:22-44) work on association learning, and processes of learning. Gagne (1985) used the term and the researcher borrowed it. The term 'Information Processing' was chosen by the researcher to provide a framework for describing learning of the foregoing kind seen in the reports of learning breakthrough. Taking each one of the two learning processes separately, they are here adopted for describing what the participants potentially used as internal processes and not outcomes learnt in the learning breakthrough. These processes are not to be confused with types of learning because they are aspects of the experience of breakthrough.

The following examples of single acts which can be a function of the internal processes of learning breakthrough experience help to define the use of this term, 'Information Processing', to illustrate the variations to the term as it is applied to this study.

ASSOCIATION LEARNING are seen by the researcher as process experiences which happen, for example, as reflexivity or a "...variety of performances with the use of legs, arms, and hands." (Gagne 1985:38). Other processes are recall, receptivity, trial and error, reinforcement. Association, too, is one where "...the presentation of one (idea) tends to arouse the thought of another." (Gagne 1985:23), and verbal information of names or labels prior learnt and taken to the learning breakthrough situation can be used by the learner to make important associations.

PROCESSES OF LEARNING are seen as control processes, "...the ways in which an individual learner may approach, engage in, and execute an act of learning..." (Gagne 1985:77). This can occur, for example, with the flow of information and relate to sensory activities, making a choice for the use of a cognitive strategy or particular skill, attending to some selected perception and the synthesis of concepts as slant of an object or the texture of material to form patterns in the mind. In addition, the processes of learning help the researcher describe the storage, feedback or retrieval of information.

There is some overlap with cognitive strategies because where cognitive strategies are used in a new way and reported as learning outcomes it can be argued that those same cognitive strategies are first learnt and brought to the breakthrough as attributes used in attaining an outcome. Hence, they are here described as part of the process experience. There could also be an overlap with externally directed processes as intellectual, motor or communicative skills, but, again they are described under the heading of 'Experience of Breakthrough' as processes and when seen to be used in a new way they are described under 'Types of Learning' as learning outcomes. Verbal information and attitudes are distinguished in the same way. Process experience is particularly explored in interviews because internal processes happen without awareness, particularly by people untrained in reflective critical analysis of their own learning, as the case with the people in this study.

By **Encounter** is meant how the learners themselves experienced the dynamic nature of the event - to describe the suddenness or unpredictability of learning breakthrough. Such descriptors can be, for example sudden, unexpected, conscious, and fortuitous. The term 'Encounter' is a misuse of the word when considering it is commonly used to describe negative or hostile meetings.

However, the most appropriate term is 'experience', but, this is not suitable because it would become confused with the same word used in the heading exploring experience generally. Therefore, the term 'Encounter' is adapted for this study.

What also drew the researcher's attention to this key concept was Jarvis's (1987:31) explanation of "...pre-conscious responses to the potential learning situation.". He went on to write that "...learning occurs to every person as a result of having experiences in daily living that are not really thought about but merely experienced.". To the researcher pre-conscious response is an encounter before a resulting realisation or understanding. The researcher's encounter at the moment of learning breakthrough was a sudden spontaneous encounter with a cognitive and intellectual event.

Impact refers to the contribution of learning breakthrough to make the learners more competent, have a better state of mind or go the extra mile, and so on. In contrast, where the term 'Encounter' helps describe what the participants report as the experience at the moment of learning breakthrough, the term 'Impact' provides the means for describing the effects of that experience. For example, impact may relate to resultant emotions, motivation, competence, expertness, becoming more flexible and so on. The researcher was helped in formulating a list of descriptive words after reading the work of Jarvis (1988). His work provided words to describe the effects of learning situations and Maslow (1970) provided words to describe human needs through stages of learning and performance which can be seen as goals learning breakthroughs achieve for the learner.

The final term, **Transformation**, is chosen to provide a way of describing the change which is seen to eventuate with each learner. Mezirow (1991:145-185) provides the background for considering the various aspects of the way adults are oriented towards different perspectives once learning occurs. The term, for example, describes the way the participants appropriated meaning and became more self-actualised, and how, after learning breakthrough, they assimilated new knowledge to become competent, flexible, and expert. The researcher, for example, changed to a new perspective for thinking about computers. What he had assimilated was knowledge of the way computers use language to activate switches. This knowledge is now a part of him and the newly created rule seen as his level of expertise.

In summary, the 'Experience of Breakthrough' provides a way to describe how learning breakthrough was experienced during and after the experience, to be distinctive from the other aspects which relate to (a) the influences prior to and during learning breakthrough, and (b) what was learnt.

In general terms, the conceptual framework provides a means for consistently examining learning breakthrough from the experiences of a number of adults. The framework is a link with adult learning concepts through the selection of key core component concepts and their variations from the adult learning literature. In addition, adult learning concepts are embedded in the way the researcher has chosen to analyse (a) the contextual situations, conditions and circumstances in which adults learn, (b) the types of learning the adult participants gain and use, and (c) the way adults experience learning breakthrough with the effects and changes which result.

In summary, the 'Context of Breakthrough' examines the influences, 'Types of Learning' examines the learning outcomes and 'Experience of Breakthrough' examines the experience itself.