

CHAPTER 6

THE COMMON FEATURES OF LEARNING BREAKTHROUGH

INTRODUCTION

By 'common features' is meant the distinctive qualities found in the reports. The chapter, "The Common Features of Learning Breakthrough", examines together the eight experiences reported separately in Chapter Five, cases from other research reported in the literature review in Chapter Two, and the researcher's experience reported throughout the Chapters.

This chapter is structured by the three headings of the conceptual framework: 'Context of Breakthrough', 'Types of Learning' and 'Experience of Breakthrough'. In the report which follows, the common features are identified and each is explained before grounding them with examples.

The common features contribute toward explaining the occurrence in more general terms and provide a basis for making conclusions and recommendations in Chapter Seven.

CONTEXT OF BREAKTHROUGH

Eight common features emerged in the analysis of the contextual aspects of the reported learning breakthrough experiences. These are labelled here as: 'Anywhere', 'Anyone', 'Intentionality', 'Diversity', 'Barriers', 'Affective Responsiveness', 'Persistence' and 'Resignation'.

Anywhere

A feature of learning breakthrough is commonly identified in the open nature of its occurrence - that it may occur in various environments, with or without a teacher, and in a variety of learning situations. Learning breakthrough can occur apparently anywhere.

Regarding various environments, the eight reported learning breakthroughs were: Coral was in an examination room, Gary on a sporting field, Jack in a TAFE welding workshop, Melinda in her dining room at home, Neil in a motel office, Norm in a classroom, Tina in a small studio, and Warren was in a classroom. Of the cases from the literature on breakthrough: Niensted (1970) and Ernest's (1987) report learners in classrooms, the accountants reported by Kawada and Johnson (1993) were presumed 'on the job', Penrose was crossing a street, Poincaré was stepping onto a bus, Halmos was in a lecture room at a university, Clement's (1988) scientist was 'on-the-job', and Archimedes was in a bath. The researcher was in a classroom, and from Chapter One, there was a report of a lady during scuba diving lessons experienced learning breakthrough while at the bottom of a swimming pool. The common feature emerging is that learning breakthrough is not confined to anyone type of environment.

Teachers are not always involved, neither is the presence of others. Coral, Gary, Melinda, Neil, Penrose, Poincaré, Halmos and Archimedes are examples where there was no teacher. Jack, Norm, Tina, Warren, reported teachers who may have influenced their learning situation. Of all the experiences, however, some individual learners reported other people being involved. Neil, for example, described how he was in conversation with a motel manager. Penrose, Poincaré, and Halmos reported being in conversation. Apart from being in a classroom full of people what the researcher remembers at breakthrough was no influence from another person. In the other extreme, Jack had the teacher present and influencing him at the point of breakthrough. Coral, Gary, and Melinda reported no other person present. There appears to be no common pattern of involvement by other people. Learning breakthrough can occur anywhere with or without people.

The reports confirm that the learners were involved with different activities to demonstrate how learning breakthroughs occur in various types of learning situations and are as follows.

Coral was involved with an academic activity in social science, the type of learning situation for her was formal.

Gary's activity was theoretical. He was seen to be in an informal situation.

Jack was learning manual skills and seen to be in a formal situation.

Melinda was involved with intellectual activity which was informal.

Neil's activity was personal change and was seen to be in an informal situation.

Norm's activity was conceptual. He was seen to be in a non-formal colloquium.

Tina was involved with developing a technical skill seen to occur in a non-formal situation.

Warren's activity was remedial seen to occur in a formal situation.

From other reports:

The researcher was involved in conceptual activity in a formal professional development course

Penrose, Poincaré, and Halmos were pursuing vocational interests and their breakthrough was seen to occur casually, in individual situations - 'stub-the-toe' type situations.

It appears that from all these sources there are a diversity of activities and situations in which learning breakthrough occurs.

The common feature is that there appears to be no social, situational or subject bounds on learning breakthrough. It has the property of manifesting itself in a variety of places and situations.

Anyone

Another feature of learning breakthrough identified here is its being experienced by a diversity of adult learners. Perhaps anyone can experience learning breakthrough.

There is also evidence of particular individual characteristics which are common to adults who are likely to experience learning breakthrough, such as the participants in this study.

However, the attributes listed below are also common to most adult learners and not necessarily distinctive of the adult learners who experience learning breakthrough.

Age is the first characteristic to be identified which ranges from twenty for Jack to fifty five for Norm - learning breakthrough not limited to any age group. Secondly, what is illustrated in the following list is a diversity of positive adult learner attributes represented in this study, that is, motivation, determination, and previous experience. The list has been compiled from the information in Chapter Five.

ADULT LEARNER	CHARACTERISTICS OF ADULT LEARNER
CORAL	She felt inadequate for the task. She made a decision to change a negative situation into a positive situation. She had a goal to get distinctions in exam grades. She was determined to succeed. She became self-confidence. She knew the system, (She had prior knowledge). She was focused on the task.
GARY	He was stressed prior to breakthrough. He understood his needs as a learner. He knew his subject, (he had prior knowledge). He could cope with the activities. He had a problem to solve. He was calm at breakthrough. He had a personal goal. He was excited at the prospect of finding an answer.
JACK	He had motivation to be the best. He had determination. He had a barrier of inappropriate habits learnt from experience. He was confident in his own and the ability of his teacher.
MELINDA	She was already competent possessing skills in her field of dance and theatre. She had a challenge. She had a compulsion forced on her to produce. She experienced moments of confusion prior to breakthrough. She was indecisive. She understood her learning needs. She acted on her needs. She had mixed feelings just prior to the break.

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NEIL	<p>He sought change. This was a motivation. He had a fear of talking with strangers. He decided to act on an inappropriate attitude. He was ambitious. He knew about the subject. He could recognise an opportunity in which to learn. He was uncomfortable in the unfamiliar learning situation.</p>
NORM	<p>He was insecure. He was indifferent. He was dependent on his group of peers. He had some previous knowledge of his subject. He had an expectancy of what he was to learn. He was frustrated over inconsistencies. He initiated a change of attitude. He was relaxed when learning breakthrough occurred.</p>
TINA	<p>She had prior knowledge of her subject. She possessed a level of competence. She had a challenge and goal. She had a model on which to emulate. She showed 'stickability'. She felt at ease with the situation.</p>
WARREN	<p>He had a disability to overcome. He was insecure. He had fears of schooling. He enjoyed learning. He developed self-esteem and self-confidence. He had skills. He had determination.</p>

In summary of the above analysis, it can be argued that any adult learner can potentially experience learning breakthrough. Whether a breakthrough occurs or not most adult learners possess: some knowledge and a level of skill, determination, goals, focus, habits, inhibitions, fears and can be insecure in the learning environment, pleasurable feelings about learning, self-confidence when sure of reaching goals or meeting expectation, 'stickability', an ability to make decisions about themselves and an ability to recognise opportunities. On comparing the list with Knowles's characteristics of an adult learner, there would be a correlation. Knowles (1990:57-63) lists the: 'Need to know', 'Learner's self-concept', 'Role of the learners' experience', 'Readiness to learn', 'Orientation to learning', and 'Motivation'.

the conclusion may simply be that any adult learner can experience learning breakthrough.

The eight study participants also come from varying walks of life. Their social status is typical of adults.

Coral is an independent person married with children and working as a care officer in a government department.

Gary is a high school teacher married with children.

Jack, recently married, is a fitter and turner apprentice working for a large local engineering firm.

Melinda is married with no children working in television and advertising. She enjoys pursuing her interests in choreography.

Norm, who is close to retirement, is a grand father and works as a technical teacher at the local TAFE college.

Neil is married with children and works as a dentist.

Toni is a married housewife.

Warren is married with no children. He worked extensively in past years in saw mills and hardware shops. He enjoys the arts, that is, he paints, carves and wood turns. He now assists people with disabilities to function in society.

Social or occupational situations do not appear to be significant factors for those who experience learning breakthrough.

There is sufficient evidence to say here that learning breakthrough can potentially occur with any adult learner, or anyone.

Intentionality

By 'Intentionality' is meant that learning breakthrough emerges as part of a broader context of learning - a context that is relative to the desired achievement of some learning outcome. While learning breakthrough may occur in a serendipitous fashion, seemingly isolated from intentionality, it may always be related in reflection by the learner to a broader learning context in which the learner is seeking some learning gains and preparing for them.

There is evidence of knowledge and skills from past experience being intentionally carried to the breakthrough event.

An exception might be incorrectly interpreted in the case of Poincaré who experienced learning breakthrough the instance he placed his foot on the steps of a bus he was boarding. Learning breakthrough seemed to occur 'out-of-the-blue', but, he too had prior knowledge of his subject and an intention to learn.

Each participating learner in this study was involved in a broader context of learning in which a clear intention is evident. Learning breakthrough was part of that broader context.

Coral was an external student having to manage her own time and resources. She was involved with academic study, particularly sociology. In addition to her studies, Coral wanted to gain high marks from her examinations and gathered information about a system which would help her achieve that end.

Gary was involved in a self-managed learning situation concerned with perfecting his already possessed personal interest in economic rationalism and had most of the knowledge and skill before the learning breakthrough.

Jack was an apprentice building knowledge and skill to become a tradesman boiler maker.

Melinda self-managed her learning situation to gather information, make decisions and created a new thing with her already highly regarded ability to choreographer dance performances.

Neil managed his learning activity himself and developed through a series of activities before coming to the point of talking to the motel manager.

Norm was involved with a seminar to develop further his knowledge and skills to function proficiently as a safety officer for a regional TAFE College.

Tina intended to sing like other singers who were professional and could sing high notes in harmony with the music. She was involved in lessons which guided and developed her ability toward using her upper register.

Warren aimed to read and write English. He pursued a cause of learning which developed his use of the English language.

Learning breakthrough, from this study, did not appear by chance, but is seen to be part of an intentional broader context of learning.

Diversity

By 'Diversity' is meant the intentional way that the learning context, in which the breakthrough is embedded, may be characterised by a multiplicity of learning interests or intentions.

It may be, for example, pursued in different subject areas, such as, mathematics, discoveries in science, problem solving, learning to balance a bicycle, or steady a ball on a finger.

The adult learners who experienced learning breakthrough could have been studying anything. The eight individual participants in this study were involved in: social science, political theory, work related manual skills, choreography, personal enrichment, professional development, singing and literacy.

Coral was studying social science.

Gary's interest was political policy, particularly economic rationalism.

Jack was learning a new skill in welding steel plate.

Melinda was involved in choreography.

Neil was interested in personality development and the skill he learnt was speaking to strangers.

Norm was involved in professional development and learnt about risk management, particularly insurance practice.

Tina was interested in singing and learnt a new skill to sing using her upper register.

Warren needed to express himself and learnt to write his story.

The researcher's interest was in computer programming and the reports in the literature reveal interests in: mathematics, science, literacy and accountancy.

Poincaré, Penrose, and Halmos were interested in mathematics.

Ernest's subjects were interested in mathematics and the use of computers.

Clement's subjects were interested in science gathering knowledge about bending and torsion forces in metal springs.

Niensted's subjects were interested in literacy.

Kawada and Johnson were interested in accountancy.

The feature of learning breakthrough expressed here is the variety of content and interests shown across the study group.

Barriers

The quality that is here identified is part of the learning breakthrough being seen as the overcoming of barriers. Without exception, some aspect of the learning in which the participants were involved eluded them to the point where they could not progress until that barrier was lifted.

Of the eight reports from the participants in this study:

Coral did not have the ability to remember masses of information.

Gary could not, with his schema of ideas, make sense of new information.

Jack had an inappropriate technique for welding and could not progress having failed to perceive a reason to change.

Melinda could not make sense of incoherent material. Without a way of unifying her thoughts, she could not progress to write the sequence of the program.

Neil was unable to talk to strangers because of his restraining comfort zone.

Norm was confused and unable to make sense of what he read and heard.

Tina could not sing like experienced singers. Without knowing how to form her mouth and throat, she was incapable of changing her voice register.

Warren could not communicate his thoughts. He was unable to understand English expression.

The researcher, too, can report a barrier. He did not have the concept of English letters translating to electronic messages. Not knowing the concept prevented him from solving problems in computer programming, detrimental to his progress.

From the literature review each person had barriers to overcome, which, after their individual breakthroughs found that they could progress toward more goals. One particular example is Poincaré who, up until the unexpected moment on entering the bus perceived the formula to understand a complex mathematical theorem which eluded him prior to the experience, but as a consequence, meant he understood the mathematics perfectly to progress and make further discoveries in science.

Age related barriers were also reported. Coral complained of her reaction time to study and to retaining information and said that it was impaired through the passage of time and not having studied for some years.

In other examples, Neil was 30 having developed a life style when he decided to change, and Melinda complained of physical discomfort. There is no evidence to support these learners overcoming their age difficulties, but the barriers age caused were seen by them as hindrances to learning before learning breakthrough, but not seen after the event.

The common feature of barriers within the learning context may be seen as an impasse until the moment of release, breakthrough.

Affective Responsiveness

The common feature of 'Affective Responsiveness' is a range of feelings, moods or emotions experienced by the learner prior to breakthrough.

From examining the characteristics of the adult learners in Chapter Five, various feelings were noted prior to learning breakthrough. They are listed as follows.

- Coral: She felt inadequate for the task.
She was determined to succeed.
She felt sure.
- Gary: He was stressed prior to breakthrough.
He was calm at breakthrough.
He was excited at the prospect of finding an answer.
- Jack: He was motivated to be the best.
He had determination.
He was confident.
- Melinda: She had a compulsion forced on her to produce a program.
She experienced moments of confusion prior to breakthrough.
She had mixed feelings just prior to the break.
- Neil: He was motivated.
He was uncomfortable in the unfamiliar learning situation.
- Norm: He was insecure.
He was indifferent.
He was frustrated over inconsistencies.
He was relaxed when learning breakthrough occurred.
- Tina: She felt inadequate for the task.
She felt at ease with the situation.

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- Warren: He was insecure.
 He had fear of schooling.
 He enjoyed learning.
 He developed self-esteem and self-confidence.
 He had determination.

The common feature identified here is the heightened emotional level prior to learning breakthrough.

Persistence

'Persistence' refers to the way the eight learners in this study report a determination to succeed - that the learners demonstrated 'stickability'.

The following examples, from the eight reports, are some of the barriers faced by the learners and their reactions. What the examples illustrate is the way each learner did not allow barriers to prevent learning.

<i>NAME</i>	<i>BARRIER</i>	<i>REACTION</i>
CORAL	1 She could not remember the material. 2 She had to learn material which was not practical in her work situation.	1 Searched for and found a method to improve memory. 2 Made time to learn a study system to overcome negative feelings.
GARY	1 He could not relax to think through his problem. 2 He was frustrated to think that something eluded him.	1 Sought an environment where he could relax. 2 Did not stop until he could explain new information.
JACK	1 He had skills he thought were adequate. 2 He was continually criticised by his peers. 3 He could not weld proficiently.	1 Allowed himself to become willing to accept another way. 2 Set himself to learn and become better at welding than his peers. 3 Practiced and watched others.
MELINDA	1 After many efforts to do so she did not understand how to incorporate her dances in a theatrical production. 2 Nothing worked. 3 She was under pressure	1 Inquired from people with more experience despite a high opinion of her own ability. 2 Stopped to start again at another time when she could work refreshed. 3 Tried different approaches.
NEIL	1 He could not speak comfortably with strangers and, thus, seldom engaged in conversation. 2 He was uncomfortable	1 Joined Amway where he had to speak to strangers in order to sell products. 2 Made the effort to speak to strangers.

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NORM	<ol style="list-style-type: none"> 1 He was frustrated by inconsistent information. 2 He was despondent. 	<ol style="list-style-type: none"> 1 Spoke to other people experiencing similar difficulty. 2 Participated in activities.
TINA	<ol style="list-style-type: none"> 1 She did not know how other experienced singers sang high notes, nor did she understand what her teacher explained. 	<ol style="list-style-type: none"> 1 Practiced despite the setback and continued with lessons.
WARREN	<ol style="list-style-type: none"> 1 He could not read or write English. 2 He denied being illiterate. 3 He had fears of schools. 4 He felt embarrassed at attending classes. 	<ol style="list-style-type: none"> 1 Asked friends to help and went to basic English classes. 2 Admitted his disability to read and write English. 3 Attended a school. 4 Persistently attended class.
RESEARCHER	<ol style="list-style-type: none"> 1 He had no conception of the function of programming language. 	<ol style="list-style-type: none"> 1 Tried different approaches, asked for help, trial routines until the 'penny dropped'.

The contribution to the study through examining the feature of 'persistence' identifies a personal characteristic of the learners which is perhaps a condition for overcoming barriers, and learning breakthrough. This feature, and the next, are noted as two personal qualities possessed by the learners and utilised by them here to progress toward learning breakthrough.

'Persistence' is seen as a feature of learning breakthrough induced by the learner.

Resignation

By 'Resignation' is meant acceptance by the learner of the situation prior to learning breakthrough - that one has done all that one reasonably can. The feature identifies acceptance without an expectation of learning - learning breakthrough.

Coral reports reaching the time when she *...thought that I would give this a go.*

Gary says: *...(prior knowledge is) probably building a sort of structure for you when you do get the pieces that link it together.* He apparently had the preparation completed and waited for a solution.

Jack had reached a point where he felt at ease accepting the teacher's method. He says: *...learning a better technique from the experience of the teacher.*

Melinda experienced a relaxed moment at a time when she was resigned to produce a program. She had apparently gathered all the information she needed - *...this piece of paper with all the things that I had scribbled out when I was at Mums.*

Neil had prepared for the moment at the Motel. He says: *...(I) usually push Tina (wife) into talking with the people and paying the bill, but this time I did it.* Neil was sure of himself going to talk to the Motel manager - resigned to the task.

Norm had gathered information, had prior experience, accepted new information as relevant, and began to participate.

Tina was confident with her preparation. She says: *...what probably contributed to the breakthrough was all the knowledge up to that point then it just all fell together. I think perhaps that it almost happened accidentally. If I hadn't had all those lessons before hand It may not have happened.* Tina had apparently reached a point where she had developed her voice sufficiently to use her upper register before *...it happened surprise surprise!*

Warren says that toward the event *...confidence definitely (grew) that is true.* He was confident of his preparation for writing to convey his thoughts - his story.

The quality illustrated by this feature appears to represent the final emotional state of the learner before overcoming individual learning barrier(s) - and achieving learning breakthrough.

TYPES OF LEARNING

Two common features emerge in the analysis of types of learning. They are labelled here as: 'Diversity of Types' and 'Cognitivity'.

Diversity of Types

The common feature, 'Diversity of Types', is that learning breakthrough may embrace any type of learning outcome.

The list, on the next page, is from the eight individual experiences recorded in Chapter Five and the underlined key concepts and terms are examples of the various types of learning gained during each participant's learning breakthrough. In the list below, internal types of learning are first reported before reporting externally directed types.

NAME	TYPE OF LEARNING
CORAL	<p>There was a combination of <u>cognitive strategies</u>: (a) associating concepts in a new way, and (b) associating a rule with the problem - to value an intellectual rule as a means of reaching a solution to remembering masses of information.</p> <p>Coral's breakthrough was demonstrating the application of a rule, an <u>intellectual skill</u> she used for completing complex written exam answers.</p>
GARY	<p>His learning breakthrough was learning a new use for a <u>cognitive strategy</u> discerning <u>verbal information</u>.</p> <p>Gary's breakthrough was an <u>intellectual skill</u> described here as an defined concept to contextualise incoherent information to develop a consistent version of his theory of economic rationalism.</p>
JACK	<p>The learning breakthrough was a <u>cognitive strategy</u> analysing concepts and discerning a connection between stored <u>verbal information</u> in the form of concepts related to welding.</p> <p>The learning breakthrough for Jack may be interpreted as a convergence of (a) an <u>attitude</u> change to adapt to the new way of welding, (b) cognition, (c) <u>intellectual skill</u> of discrimination and (d) demonstrating fine and gross <u>motor skills</u>.</p>
MELINDA	<p>Melinda discerning facts from <u>verbal information</u> was manipulation of her thoughts, the <u>cognitive strategy</u> seen here as Melinda's learning breakthrough.</p> <p>The type of learning seen to occur as a breakthrough was developing a complex higher order rule in problem solving, interpreted in the conceptual framework as an <u>intellectual skill</u>.</p>
NEIL	<p>The type of learning, represented as the creation of a new <u>cognitive strategy</u> to become conscious of change enabling him to recognise <u>verbal information</u>.</p> <p>Neil's breakthrough is here interpreted as <u>attitudinal</u> because it is a change in his self-confidence occurring as the desired outcome.</p>
NORM	<p>The <u>cognitive strategies</u> are, in summary, recognising concepts in a particular way, distinguishing a connection and discerning relevance in stored and new <u>verbal information</u>.</p> <p>Norm's breakthrough was learning an <u>intellectual skill</u> seen here as a defined concept.</p>

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TINA	<p>Learnt in breakthrough was a <u>cognitive strategy</u> of mnemonics which was learnt as her system for remembering to sing high.</p> <p>Tina's breakthrough is seen as learning an <u>intellectual skill</u> of concept forming and a new fine <u>motor skill</u> enabling her to make the sound.</p>
WARREN	<p>A convergence of multiple <u>cognitive strategies</u>, identified as processes for comprehension of the use of language, is seen occurring at learning breakthrough.</p> <p>Warren's breakthrough is seen here as learning a <u>communicative skill</u> to express his own life experiences.</p>

Types of learning identified in the conceptual framework were: 'Motor Skills', 'Communicative Skills', 'Verbal Information', 'Cognitive Strategies', 'Intellectual Skills' and 'Attitude'. It is found that all the learning types are represented in the learning breakthrough experiences of the eight participants.

Here, the property illustrated, is the range of learning outcomes potentially included in any given learning breakthrough.

Cognitivity

By 'Cognitivity' is meant that in all cases there is a cognitive strategy and that cognitive strategies appear to be a central feature of the learning involved in the learning breakthrough. There is identifiably one learning outcome at the point of learning breakthrough that is central to the learners' perception of the breakthrough itself.

The learning breakthrough experience exhibits a common pattern: (a) a stage of inability where whatever is needed to lift the learning barrier eludes the learner, (b) a moment of breakthrough, (c) insight or an immediate improvement and (d) a period of growth. The eight learners in this study have explained that they used and learnt various processes, strategies and skills throughout the broader learning breakthrough experience. What is illustrated here is a unitary process reported at learning breakthrough - the (b) step in the sequence doing or producing a learning breakthrough.

Two reports from Chapter Five and the researcher's own report are used as examples.

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- Coral first:*
1. recognised her study need.
 2. read about a system for study.
 3. comprehended what she read.
 4. selected a strategy for perceiving relevant parts she read in the study material.
 5. developed an intellectual skill for classifying acronyms.
 6. creating the rule for the use of the system in exams.
 7. rehearsing the system to reinforce the learning.
 8. associating relevant information.
 9. wrote.
 10. translate verbal information.
 11. use of facts and propositions.
- before:*
12. associating the rule with a possible solution to remembering masses of information.
 13. application of the rule created earlier.
 14. generalising to make the system operational or automatic without recourse of thought.
 15. confidence grew.

The interpretation in terms of the types of learning:

- Coral first used:*
1. cognitive strategy.
 2. communicative skill.
 3. cognitive strategy.
 4. cognitive strategy
 5. intellectual skill
 6. intellectual skill.
 7. cognitive strategy.
 8. cognitive strategy
 9. motor skill.
 10. communicative skill.
 11. verbal information.
- before:*
12. cognitive strategy.
 13. intellectual skill.
 14. intellectual skill.
 15. attitude.

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- Jack first:*
1. being willing to accept the new technique and forget the way his father had taught him.
 2. recognition of a reason to change.
 3. compared different methods.
 4. distinguishing worth.
 5. manipulated the visor and hand piece.
- before:*
6. analysed a connection between what was correct and what was not.
 7. making a distinction.
 8. using the equipment.
 9. developing a new concept for welding.

The interpretation in terms of the types of learning:

- Jack first used:
1. attitude.
 2. cognitive strategy.
 3. cognitive strategy.
 4. intellectual skill.
 5. motor skill.
- before:
6. cognitive strategy.
 7. intellectual skill.
 8. motor skill.
 9. intellectual skill.
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- Researcher first:*
1. developed eye hand coordination of the computer keyboard and screen.
 2. observed others.
 3. clarified information through trial and error.
 4. discerned routines functioning correctly.
 5. responded positively.
 6. clarified order.
 7. selected appropriate program routine.
 8. trialed routine (a new strategy).

- before:*
9. adapting his thinking about the association between the computer and programming.
 10. becoming confident.
 11. creating a rule for understanding the translation of computer language into a code used by the computer mechanism.
 12. verbalising the rule.

The interpretation in terms of the types of learning:

- Researcher first used:
1. motor skill.
 2. verbal information.
 3. cognitive strategy and information processing occurring simultaneously
 4. cognitive strategy.
 5. attitude.
 6. intellectual skill.
 7. cognitive strategy.
 8. cognitive strategy.
- before:
9. cognitive strategy.
 10. attitude.
 11. intellectual skill
 12. communicative skill.
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Seen in each of the cases above is a cognitive strategy at the point of learning breakthrough.

In the remaining six of the eight cases reported in Chapter Five at the moment of learning breakthrough:

Gary used the cognitive strategy of discernment.
Melinda learnt to discern facts and analyse them seen as a cognitive strategy.
Neil recognised change interpreted as a cognitive strategy.
Norm used three converging cognitive strategies to comprehend.
Tina used a cognitive strategy of mnemonics.
Warren used a process of comprehension seen as a cognitive strategy.

It is sufficient, at this point, to illustrate the adult learning term, 'Cognitive Strategy', as one central feature of the learning of learning breakthrough until further research can confirm or refute a discrete cognitive process as the method for lifting the learning barrier. However, it was found here that in each learning breakthrough reported there was a cognitive strategy.

EXPERIENCE OF BREAKTHROUGH

Ten common features emerge in the analysis of the experience of breakthrough. They are labelled here as: 'Barrier Lifting', 'Instantaneous', 'Unpredictable', 'Positive Experience', 'Cumulative', 'Reinforcement', 'Transformative', 'Developmental', 'Memorable' and 'Effortless'.

Barrier Lifting

By 'Barrier Lifting' it is meant that the participants each experienced learning breakthrough as a release from a situation in which progress was blocked as noted earlier under the heading 'Barriers'. An aspect of each learner's experience eluded them until breakthrough, and whatever eluded them previously did not elude them after the event.

What is identified below are their respective barriers and how they were lifted.

Coral could not remember the volume of information needed for high marks in exams until her breakthrough when she began to remember masses of information.

Gary's theory could not explain new information until breakthrough and the new information made sense.

Jack could not perform his welding task to standard, experienced a breakthrough and began welding appropriately.

Melinda could not sequence the program had a breakthrough and made sense of incoherent material. She could write the sequence of the program.

Neil was unable to talk to strangers encountered a breakthrough and enjoyed his conversation.

Norm could not grasp the concepts put forward at the seminar until his breakthrough where he found an ease for comprehending what he read and heard.

Tina could not use her upper register, experienced a breakthrough to sing using the upper register.

Warren could not communicate his thoughts. He experienced a breakthrough and wrote his impression of a life story.

Instantaneous

The common feature of learning breakthrough identified here is the characteristic of the speed at which learners become aware of learning - an experience that is marked by the realisation of the pace of change. In the majority of cases it is seen as instantaneous. For example:

Coral reported an instant realisation of a change to her ability.

Gary reported a sudden understanding.

Jack's report inferred a relatively sudden occurrence where while practicing the release of skill became realised in producing the weld.

Melinda expressed suddenly finding ease in sequencing the program.

Neil's becoming comfortable with talking to a stranger was reported occurring over a short period of a conversation. It was relatively sudden.

Norm comprehending what he read and heard was reported as a relatively sudden occurrence. He expressed it as happening over a short period.

Tina expressed suddenly singing in upper register.

Warren expresses suddenly understanding language to write his own story.

Where learning breakthrough is a singular cognitive strategy, a case may be argued that cognition is instant in occurrence. Five reports attest to being acutely aware of instant learning. The other three learners in the study became aware over a short period. Their awareness may be deemed to

have been interrupted either by other strategies coming into play at the same time like the cases of Coral, Jack and Norm, as seen with 'diversity of types', or some external influence delaying the realisation of breakthrough such as the instance with Neil (distracted in conversation). These experiences are interpreted here as being relatively sudden in occurrence.

In addition, from the literature review there are reports of sudden occurrences. Poincaré, for example, who received a complete understanding of his particular mathematical formula as he stepped on a bus was reported as perceiving his answer the moment he put his foot on the step of the bus. How long does that take?. Penrose too expressed only in a few moments at one point in time reaching an understanding. Ernest described his observations as instant understanding and application of mathematical insights. The researcher can also report an instant learning breakthrough experience as he perceived instantly learning an association between too concepts.

Unpredictable

Adult learners in this study reported having experienced a feeling of surprise. 'Unpredictable' is a way of describing this feeling.

As the learners became conscious of the reality of having achieved their desired outcome, when what was expected was continued blockages, breakthrough meant relief from the problem which eluded them a moment previous to the occurrence, but they had not been sure that it would happen.

Coral for instance, did not expect the extent to which she remembered masses of information, Gary did not predict the timing of his answers, Jack also did not predict the timing, Melinda had no conception of what was to occur the moment she touched the typewriter, Neil did not expect to come away confident from the conversation with the motel manager, Norm was surprised at how he reached an understanding and not expecting the timing, Tina did not expect upper register to sing like experienced singers, and Warren did not expect to be able to express his ideas in such a fluent way with using writing.

Three accounts from the literature review reveal a surprise aspect to the experience of learning breakthrough, Poincaré, Penrose, and Halmos.

These accounts were possibly the most bazaar because their learning breakthroughs' seemed to come from no-where. Their conversations at the time of breakthrough would be expected to distract them and not help learning because the moment was casual and the conversations were about unrelated things.

The researcher, even though he was involved in related pursuits and expected some success from his endeavours, can report that when it occurred it was a complete surprise. Learning breakthrough was not expected to provide such relief for knowing that the problem was solved, that he could immediately with ease understand computers and be free to achieve so much with his work at the time. Expected were more insurmountable barriers.

This feature of unpredictability identifies how learning breakthrough may not be guaranteed to occur even when the conditions with the learner, the environment and the situations are supportive. Being unpredictable may mean that the occurrence may or may not happen. It is also seen how each learner failed to predictable the extent to which they were enlightened. The insights that are seen to develop as a result of the learning breakthroughs were generally expressed as substantial gains, eureka, Aha! and surprise.

Learning breakthrough is seen to have a mysterious feature in the sense that it is unpredictable.

Positive Experience

By 'Positive Experience' is meant that the emotional dimension to learning breakthrough is seen as constructive not destructive. Emerging for the learners are: of feeling pleasure, confidence and the incentive to further study.

As for pleasurable feelings for example, it is a common story that Archimedes went running naked in the streets exclaiming "eureka! eureka!". The researcher, too, was certainly delighted by having learnt the essential basis for programming computers. He did not exclaim eureka nor was he naked, but, he felt like it.

Apart from the joy expressed, each research participant indicated positive experiences of confidence, and motivation. For an example of confidence, Melinda was elated having written her musical program and became confident as a result, and Coral exclaimed, “*Wow! this is the way to do it.*” and continued to use the system to succeed in exams and her course.

Of the other participants:

Gary referred to the occasion as a thrill knowing he could explain what he found prior as incoherent.

Jack was confident and motivated to solve problems.

Neil felt competent to talk comfortably with strangers and was relieved. The incentive for him was to increase his dentist business, have meetings with staff and talk more to his patients.

Norm was confident and self-assured.

Tina reports feeling elated and confident of seeing her desires met. Tina became motivated to sing in opera.

Warren expressed his feelings as relief and infers that his self-esteem was high. The incentive for Warren was to write as an occupation.

Without exception each person reports experiencing learning breakthrough as some form of positive emotion or self-esteem. Included here is the feature of learning breakthrough as the motivation to go further to achieve greater things.

Cumulative

By ‘Cumulative’ is meant that the learning breakthrough builds upon and extends prior learning in whatever outcome categories are involved. This is illustrated in the following examples from the eight participants’ reports:

Coral brought knowledge of the system to her breakthrough. The outcome was a rule associating the use of this knowledge in a new way. From the experience she appropriated the skill to apply the rule in other similar instances.

Gary had the necessary information which, through breakthrough, he made sense of and restructured his theory. He went on to develop his theory building his schema for thinking about economic rationalism to make sense of further information.

Jack had already developed a level of welding skills prior to the occurrence of learning breakthrough. After developing a new motor skill he went on to solve welding problems using the skill developed at learning breakthrough.

Melinda had the music and the dance steps needed for constructing the program sequenced at learning breakthrough. What she projected into the future was an ability to produce other programs for her particular dancers.

Neil knew the way to approach strangers and had previously practiced talking skills, but, what was gained at breakthrough was a new attitude. He appropriated the new attitude, applying it to conversations with his patients and being comfortable in the process.

Norm possessed the information on which he based his understanding of insurance. His breakthrough was to reconceptualise this understanding. Moving from his breakthrough, Norm demonstrated the appropriation of the new concept through applying new principles of insurance in a simulated environment before performing his tasks back at his work place.

Tina had already developed strength of voice and knew the sound upper register made, bringing the knowledge and skill to the learning breakthrough situation. She learnt to harmonise using her upper register to develop a new singing range. She now sings in operatic productions.

Warren developed an understanding of language upon writing his story. He now writes reports as part of his care duties with people with disabilities.

The researcher had developed skills with computers. He already developed a way of testing ideas, and had the motor skill to type before his breakthrough. He went on from his learning breakthrough having assimilated the learning outcome and then teach that concept to others.

Penrose and Poincaré, (Penrose 1991), similarly from other research explored in the literature, had pondered their science prior to their particular breakthroughs and on recalling the knowledge in a new way broke through. They moved from the breakthrough to develop their theories.

This common feature illustrates the value of learning breakthrough being a progressive part of, not isolated from, the broader learning experience.

Reinforcement

The feature of learning breakthrough here identified is that the learning itself is subsequently focused upon and reinforced by the learner - commonly through rehearsal of the learning or practise of the skills learnt. Alternatively, it may be seen as a degree of uncertainty, where in the learner wants to prove something to themselves about their learning. Inferred here, the learner has a quality of emotion and confidence building.

The former has a process quality that is a further step in the transformation process of assimilating the knowledge and/or skill.

From the study of the eight individual experiences.

Coral repeated the system.

Gary tested his new understanding talking to his wife.

Jack practised the new welding technique.

Melinda kept visualising the theme to determine relevant detail of the program.

Neil practiced talking to strangers.

Norm revised his comprehension checking details through a trial practice.

Tina received reinforcement from her teacher who pointed out that she had achieved the desired result before herself recounting and comprehending what she had just achieved.

Warren's reinforcement was his achievement and the self-esteem.

From the self-reports identified in the literature:

Penrose recalled the information later.

Poincaré's experience was similar to Penrose.

From the research described in the literature review:

Clement's (1988) scientist recounted his breakthrough audibly as Clement recorded his thoughts.

From the researcher:

He responded to a fellow student's request for help by verbalising his newly found understanding.

Such is the surprise of these learners in experiencing learning breakthrough that they repeat, act out or verbalise their achievement and thus reinforce the learning.

Transformative

The transformative feature of the learning breakthrough experience is that it is seen by the learner as reportedly changing them as individuals - in their capabilities, confidence, and social role.

From the report in Chapter Five, transformation for the eight participants are perceived by them as follows.

Carol's transformation was, she says *...it breed success to keep going...it is automatic. I automatically do it now with the lectures that I get. It changes from learning (the system) to being a process and part of me and the way I operate.*

Gary's skill forming theory from incoherent information is reported by him as: *Once you have experienced it once, it is like a kick that you get to keep you in this mode of thinking.*

Jack is competent at welding in the work place using the technique learnt at breakthrough and reports that: *...(it is like) acquiring your own style... It was as if your mind says: and we'll put it in the head and lock it away and then it will become second nature...you are not physically concentrating, it is in your mind and it happens - like driving a car.*

Melinda, subsequent to breakthrough, transferred her ability to incorporate her dances in the professional stage production and now understands how to utilise her dancers in similar performances. She says *...a good choreographer listens...* and reports that her dancers are *...on stage in a weeks time (now past).*

Neil's ability to speak comfortable with strangers was demonstrated at interview and he explains that he *...you seem to tell by intuition. I am more of a reality type of person and want to do things rather than just knowing about them...(I now hold) staff meetings.*

Norm was proficient at advising college executive of the process and concept of insuring in a risk management system. Norm inferred that he *uses it in an enlightened sense...it was a sense of security...when you go back to the college you want to feel inadequate because you are expected to speak with a level of authority.*

Tina's voice range had changed, she says *...I was always considered alto and always thought of myself as an alto because I thought I couldn't sing high...after (learning breakthrough) I realised that I was actually a soprano.*

Warren said at interview that *...now I work with reading and writing...I'm writing reports now.*

There is a transformation which can be seen to originate at learning breakthrough.

As additional evidence from the point of view of self-reporting his own transformative experience:

The researcher ...understands the computer mechanism more now than when he first understood the basic principle from the consequence of learning breakthrough. However he can relate to that moment at breakthrough as the time when he first learnt the basis on which his current computer skills are founded.

From the literature:

Niensted's (1970) students, she reports, continued to progress with reading and she identified the moment at breakthrough as the time the students were enabled to make improvement. In other cases from the literature review, Penrose, Poincaré and Halmos, reported that their knowledge was innate change and the knowledge in itself had not changed over the years.

There is a quality of permanency seen here with the learners apparently retaining the knowledge and/or skill(s) gained as a result of learning breakthrough.

Developmental

'Developmental' is a common feature of learning breakthrough which is a component of a developmental sequence of events - the process in which the learning breakthrough is embedded.

The process is in Table 6.1 located on the next page. Presented are four steps.

Step One how the learner initiated their experience.

Step Two the opportunity either created by the learner themselves or presentation of a situation.

Step Three the breakthrough.

Step Four the consequence.

The steps in the process are in the sequence of the reported events before, during and after learning breakthrough and have been generalised to form a four step change process. Four steps were chosen by the researcher to reduce the complication of recording infinite steps.

It is argued here that four major steps exist in the change process represent: Step one and two before learning breakthrough representing the

development leading up to the event. Step three is during and step four after learning breakthrough.

Table 6.1 The Change Process

(Table 6.1 has been compiled by the researcher from information contained in the individual experiences reported in Chapter Five.)

<i>LEARNER</i>	<i>STEP 1</i>	<i>STEP 2</i>	<i>STEP 3</i>	<i>STEP 4</i>
CAROL	develops supporting knowledge and skills.	recognises exam activity as opportunity to apply skill.	skill manifests through application.	assimilates skill.
GARY	finds incoherent information conflicting with his view point.	seeks environment to think without interruption.	realises similarities of information and makes a connection.	modifies his viewpoint.
JACK	recognises difference and evaluates worth.	changes his attitude to accept new way by being inspired by his classroom teacher.	releases skill.	finds an ease in operating welding equipment in industrial situations.
MELINDA	gathers information.	compelled to produce a program.	finds a pattern emerges to sequence information.	writes the program and becomes more intuitive.
NEIL	develops skill.	recognises opportunity to trial skill.	applies the skill in a realistic situation.	confirms his ability and accepts it.
NORM	intends to learn about insurance and gathers information.	reduces any anxiety and begins to participate.	comprehends what he read and what was said.	appropriates new knowledge.
TINA	embraces a goal.	develops physically, psychologically and emotionally.	releases her latent skill to sing using the upper register.	becomes soprano instead of alto.
WARREN	decides to change.	seeks help and develops skills.	writes his story.	appropriates his skill and transfers it to life situations.

The table intends to indicate how systematically each learner went from a period of inability to a new transformation to achieve in their respective endeavours a new appropriated skill through the means of learning breakthrough - an experience which is seen here described as a transformative change process

The feature of 'Developmental' provides a means of indicating a change process within the experience of learning breakthrough.

Memorable

By 'Memorable' is meant the conspicuous quality of learning breakthrough as a notable experience, one that features importantly as an experience in the memory of the learner. This is evident by the readiness with which learners articulate their detailed experience of learning breakthrough in this study - over a long period.

Perhaps some striking quality to mark the occurrence and make it notable is pleasurable feeling associated with conquering a problem. Where most learning occurrences pass without notice - it is enough that one has learnt something - this learning instance is remembered. In some cases the experience is apparently remembered through its association with the emotions involved before, during and after the occurrence. In such cases the memory of the emotions raises the memory of the associated learning experience. For an example, Melissa first remembered being *...grumpy...* then she explained that *...(she) envisaged the problems anticipating them before they happened.* Neil too in a sequence of remembering says: *...I was not comfortable...talking was when I was out of my comfort zone...I (then) became comfortable.*

There were other instances in the reports where the learner remembered the detail and then the associated emotion(s). Again the emotions were part of the remembering process. Norm for example says: *I certainly started to understand ..once that happened...I was more confident,* and there was a point made regarding his involvement with his peers when they started to participate in the proceedings. Norm says, following his explanation that *...it relaxed me* - the associated emotional response.

The participants were required, during data collection, to re-think their experience at numerous interviews. This raises another dimension to memory. Without exception, each person maintained consistent reports to provide the basis for (a) verifying reports and (b) saying here that this occurrence is memorable.

Examining the verified reports, three examples are indicative of the detail which each of the eight study participants remembered at the initial interview and during subsequent interviews. They are:

Tina

Tina remembered her learning breakthrough experience after twelve years, that is, remembering watching the pianist's hands for a cue, aspects of the place such as the atmosphere, characteristics of her teacher as supportive, her attitude toward singing and the teacher, and so on. In addition to remembering external aspects of her experience, she remembered internal processes and feelings. For example, she remembered she had knowledge and used it in the experience, she remembered why she felt comfortable and how she made the sound during that enlightened moment.

Gary

Gary remembered the step by step process of coming to the point of a breakthrough and why - his drive and circumstances surrounding his breakthrough. He remembered his feelings particularly of a rush of energy around the time of learning. The mental state he was in during the time prior to his breakthrough and how he managed the task of becoming relaxed was all clearly articulated. His feeling for knowing what was essential to solving his problem was conveyed along with the way he helped his concentration by talking the issues through silently to himself.

Melinda

Melinda remembered the way in which she managed her frustrations. How she gathered the information. Who was helpful and who was not. What was used as learning aids. She clearly articulated her problems and remembered details of the effects they had on her activities. Melinda remembered the time of the day and the reasons for choosing the day and time.

From other research identified in the literature review on breakthrough Penrose and Poincaré remembered detail of their learning breakthroughs after years had lapsed. Their seemingly remarkable breakthrough were mere sensations and they remembered them, the time, the place, the circumstances and the distractions. In the case of Halmos, he too remembered details of his learning breakthrough and after forty years remembered the room, its number, the person with whom he was in conversation and his dramatic response of a direction in his life's role. The researcher too can still remember the good feeling, where he was, who was involved, what his thoughts were at the time, and the gesture turning to the student seated next to him, explaining the solution, the processes involved to explain the type of learning and remembering what the learning outcome meant to him at the time.

The common feature that is illustrated by the detailed articulation of events and elements of learning; breakthrough is described as 'unforgettable', the quality of markedness.

Effortless

The feature 'Effortless' is here identifying learning breakthrough in its 'extraordinary' nature. It is that learning breakthrough is different from other learning experience. It is seen by the learners as being

different because learning was effortless when it came to the actual learning breakthrough.

From other research explored in the literature review in Chapter Two, Ernest (1987:10) writes about a flash, he describes:

...moment of inspiration...flashes of understanding...as they (his students) make a mental leap...At one moment the child (learner) is without the insight. A few seconds later the insight is being applied in a problem situation.

Ernest (1987:10) summarises with the phrase "...this magic moment...". It can be argued that Ernest's observation of students with breakthroughs was that the experience is unique from other learning events he had previously observed because of the apparent effortless with which his students reached their solutions.

Niensted (1970:1) made the comment that:

Because of the long period of frustration and the seemingly insurmountable barriers, the dramatic breakthrough into use of words came as a miracle.

Niensted, too, identified as separate events seen here as learning breakthrough. She used word descriptors as 'dramatic' and 'miracle' and through the use of such words infers here some effortless act of learning.

Apparently, from the way that Penrose concluded as remarkable describing Poincaré's breakthrough. Penrose (1991:542) identified an extraordinary quality of the experience. Their experiences as seen in the foregoing descriptions and previous Chapters is an example of minimal effort - their experiences were mere flashes of thought while they were engaged in other activities.

From the research participants, Gary listed several ways in which he felt learning breakthrough was different from any other learning experience. He says *...I thought that it was the speed at which the ideas came... it was almost instant assimilation of so much knowledge...it was not structured...there was a heightened awareness and exhilaration...there was enormous release...it was obligation free...it was not systems imperative...it was personalised...and so on as he continues to explain. Tina said that she can identify a difference because it was *...important to her*. Neil too said it was different. He reported that *all of his other learning experiences have been structured...To me it is completely different. It is coming from within me and it is not for outside scrutiny*. Gary, Tina and Neil also concurred*

while questioning each other on the matter during the group session. They agreed that learning breakthrough was *...without pressure...* and it was *...a free-for-all...* Tina added that *...it is perhaps a more enjoyable [learning experience] than others that we have had in the past.*

In summary, the points to emerge from the eight participants to support the researcher's findings of an effortless experience and an extraordinary learning phenomenon are: sudden pace of learning, no structure, obligation free, heightened awareness without effort, release, and personalised within one's own resources.

The common feature of learning breakthrough which is identified here is its difference in nature compared with other learning with its recourse to objectives and structure.

COMMENTS

There have been twenty common features identified from the individual experiences of the eight study participants. These common features explored here are indicative of the nature of the learning breakthroughs experienced by people reported from other research, the researcher and the eight study participants. Common features provide a profile of the phenomenon which will contribute toward establishing conclusions about this research and help with developing recommendations in Chapter Seven.

The contribution that the synthesis in this Chapter has provided may be seen in the various qualities identified to illustrate the complexity and variation found associated with learning breakthrough experience.

CHAPTER 7

THE CONCLUSIONS AND DISCUSSION

INTRODUCTION

The purpose of the study was to explain the researcher's experience of learning breakthrough and find an answer to the question: What is learning breakthrough?

In this Chapter, the major findings of this study are presented and recommendations for further research and educational support for learning breakthrough is identified.

The eight case studies on which the research relies are:

Coral's breakthrough in which she remembered masses of information during university examinations.

Gary restructuring his theory of economic rationalism after his breakthrough to make sense of inconsistent information.

Jack's breakthrough to weld steel plate using a new technique.

Melinda learning to choreograph her dance students in staged public performances by sequencing incoherent information.

Neil discovering how to talk comfortably with strangers.

Norm comprehending insurance practices in risk management after his breakthrough in making sense of incoherent information.

Tina discovering that she could sing in the upper register.

Warren who began expressing his thoughts in writing as never before.

The three self reported instances of learning breakthrough which add to this study are from the review of literature in Chapter Two. They are:

Penrose who formed his theorem concerning the understanding of 'Black Holes' in the Astrophysics field of science after his breakthrough to associate between memorised facts

Poincaré who realised a transformation with defining Fuchsian functions. He had recognised, during learning breakthrough, a connection between these and those of non-Euclidean geometry.

Halmos who was talking to a friend after a lecture and, similar to Penrose and Poincaré, 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 this learning breakthrough.

The exploration of the eight cases and the cases identified from the review of literature on learning breakthrough satisfied the researcher's curiosity about his learning breakthrough because the individual reports provided similarities of experience.

CONCLUSIONS

Twenty common features of learning breakthrough were identified in this study. The term 'Learning Breakthrough' is now established as a particular term for describing a specific experience of adult learning of the type identified by the common features.

Learning breakthrough is found to occur **anywhere**, with **anyone** with a **diversity** of learning interests. The learners were perceived **intentionally** seeking a desired outcome and preparing for it. There were **barriers** to overcome, but, the learners demonstrated **persistence** and had an **affective responsiveness** to changing feelings. In addition, learners demonstrated, just prior to the event, a sense of **resignation** that one had done all that was reasonably required to lift the barrier.

The nature of the learning outcome from breakthrough emerges as a **diversity of types** having identified examples of each of the types of learning used in the framework developed for this study.

In each learning breakthrough reported there is evidence of **cognition** - a cognitive strategy learnt or used in a new way and described here as a learning outcome from breakthrough.

The learners experienced the phenomenon with an **instantaneous** lifting of their respective **barriers**. Also found is a quality of **unpredictability** where learners seemed to be unsure of reaching their

desired goal. There was an emotional dimension seen as an aid for remembering the event - a result of learning breakthrough and labelled '**Positive Experience**'. A **cumulative** feature is identified which describes the way the learners built on what they already knew or could perform as skills. In the post learning breakthrough experience the learners were seen to focus on and rehearse new knowledge and skills to **reinforce** what they had learnt.

The **transformative** dimension was associated with the appropriation of learning and changed them and their social roles. Affecting the change was a **developmental** process perceived to occur as a series of steps where the learners progressed toward, and passed, their learning breakthrough. Lasting knowledge and skills are seen to begin with learning breakthrough.

Breakthrough is found to be memorable, therefore, a common feature of this phenomenon is labelled '**Memory**'. Finally, learning breakthrough was an **effortless** experience because the participants perceived the learning breakthrough event differently having qualities of ease when it came to the actual event. Learning breakthrough appeared to occur without recourse to rigorous thinking or any deliberate physical actions.

DISCUSSION

From the review of literature, seven features were identified and labelled as follows.

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

The result of comparing what was found in the literature and in the study was a degree of correlation between the findings. The discussion which follows examines this correlation by comparing what research in the literature reveals compared with what this study reveals regarding similar qualities and aspects of learning breakthrough.

No substantive qualities of learning breakthrough identified from the literature were found to differ in the cases stated here. Anything other than uniformity of learning breakthrough may be attributed to the general lack of specificity in the findings generally from the literature.

This study did attribute to some negative qualities, that is, those which focus on emotions, barriers and the unpredictability of the learning breakthrough experience.

The seven features identified above will be used to structure the discussion.

From the literature, **singular** was identified as a specific barrier lifted by a single learning breakthrough. This study identified as singular a specific barrier and that learning breakthrough is a single, easily distinguished event lifting the barrier - that learning breakthrough can be isolated from other learning events. Uniformity of learning breakthrough is a single event lifting a specific barrier to learning allowing the learner to progress.

The internal process lifting the barrier was identified as a **cognitive** strategy. In the literature, the concept of 'cognitive' identifies the quality of learning breakthrough that, in all cases, there is a cognitive strategy - either being learned or being learned for use in a different way or in a different context. The specific cognitive strategies identified in this study differed across cases and included association, analysis, reasoning, generalising, coding, discernment and mnemonics - but in all cases at least one was importantly involved.

The **unexpected** qualities of learning breakthrough found in both the study and other research was learning breakthrough's unpredictability. In the study, learning breakthrough was found to occur with anyone, anywhere, with a diversity of interests and breakthrough apparently was not planned - the occurrence just happened. In other research, learning breakthrough was found to occur in many different types of learning and social situations, involving many different kinds of activities and subjects undertaken by a diversity of people. The timing of the occurrence was unforeseen and it was a surprise to the individuals involved when it occurred. Both areas of research describe similar aspects of unpredictability.

The learning breakthrough in the majority of cases was seen to be an **instantaneous** experience. Niensted (1970:4) referred to as learning breakthrough an “...instantaneous improvement.” Ernest (1987:10), describes the experiences of his students as “...flashes of understanding...”. Poincaré describe learning breakthrough as occurring “...at the moment I put my foot on the step (of the bus), the idea came to me.” (Penrose 1991:541). Penrose (1991:544) wrote of himself “...a thought which had momentarily elated me by providing the solution to the problem.”. Clement (1988:57) describes the scientist's eureka experience as an “...extremely fast emergence of a new idea.”. This study identifies a sudden experience with most participants using the term instant and a few preferring to report breakthrough occurring relatively sudden. The majority of reports identify learning breakthrough occurring suddenly.

From exploring the **transformative** dimensions of learning breakthrough the research in all cases found a permanent change occurred to each learner. The learners reported being more self-actualised - that they had further developed their individual knowledge and skill and had appropriated learning.

A **pleasurable** experience was reported in all cases. Clement's (1988:27-8) scientist used the word Aha! to express his joy. Niensted's (1970) students expressed joy and satisfaction. Ernest's (1987) students expressed pleasure with exclaiming Aha!. Poincaré expressed pleasure with a certainty of knowing and Penrose expressed elation (Penrose 1991:543-4). The study participants expressed all forms of pleasurable emotions.

Both areas of research found that the learners were able to remember detail about their respective learning breakthrough experiences even after long periods. The **memorable** feature of learning breakthrough is seen uniformly as a positive experience providing clarity and the details of the event were remembered after a period of time.

The following Table 7.1 is explicit information summarising the foregoing discussion. The table illustrates the degree of correlation evident across the two areas of research.

Table 7.1 The Correlation between the Study and Other Research

(Table 7.1 has been compiled by the researcher from information contained in the above discussion and supported by information taken from Chapter Two and Chapter Five.)

THE FEATURES IDENTIFIED FROM THE EIGHT STUDY PARTICIPANTS	THE FEATURES IDENTIFIED FROM THE REVIEW OF LITERATURE
BARRIER:- describes a specific problem overcome by a single event.	SINGULAR:- describes a specific problem with a subject, topic or function which held back progress lifted by a single learning breakthrough.
COGNITIVE:- describes a cognitive strategy learnt or used in a new way.	COGNITIVE:- describes an internal process used by the learner to lift the barrier which prevented progress.
UNPREDICTABLE:- describes an unexpected event occurring to anyone, anywhere and the impact of the results were not predicted.	UNEXPECTED:- describes the manifestation of the occurrence in any situation, with all sorts of people doing all kinds of activities and subjects. Learning breakthrough's timing was unforeseen and a surprise.
INSTANTANEOUS:- describes learning breakthrough occurring suddenly.	INSTANTANEOUS:- describes learning breakthrough occurring suddenly.
TRANSFORMATIVE:- describes permanent change, building on the attributes possessed by the participants.	TRANSFORMATIVE:- describes new knowledge and skill which learners appropriated to use in new challenges.
POSITIVE EXPERIENCE:- Describes a positive emotion as a result of the learning breakthrough.	PLEASURABLE:- describes the elation and self-esteem as a result of learning breakthrough.
MEMORABLE:- describes the ability of the learners to remember details of their experience after a period of time, in some cases years.	MEMORABLE:- describes the learner remembering details of their learning breakthrough after years had elapsed.

After examining the uniformity of features there remains other features identified in the study that are not explicitly identified from the literature. They are: ‘Anywhere’, ‘Anyone’, ‘Intentionality’, ‘Diversity’ of learning interests, ‘Affective Responsiveness’, ‘Persistence’, ‘Resignation’, ‘Diversity’ of learning types, ‘Barrier Lifting’, ‘Cumulative’, ‘Reinforcement’, ‘Developmental’, and ‘Effortless’. The extensive exploration of the eight learning breakthrough experiences using the conceptual framework may account for the noting of these additional features.

Anywhere describes the variety of situations and environments in which learning breakthrough was reported to occur in both the literature and the study, but, particularly explored in the study.

Anyone is found to experience the phenomenon not only adult learners. This is assumed from the diversity of people found in this study and the learners in the literature where they range in age, gender and occupation.

Intentionality inferred in the literature and particularly described in this study correlates through the learners in both areas of research having the desire to achieve individual goals and intentionally engaging in activities to reach the goal.

Diversity of learning interests is evident across both research areas. Learners were separately involved in a single learning interest and intention in which their breakthrough was embedded. However, across the research group is a multiplicity of learning interests. Learning breakthrough can conceivably occur with learners studying anything.

Affective Responsiveness is evident in the study as a range of feelings, moods or emotions experienced by the learners prior to breakthrough. The research in the literature does not record any specific prior feelings only inferred frustrations where some learners, prior to their breakthroughs, were unable to grasp whatever eluded them. Clement (1988), for example, identified frustrations existing with the scientist as he worked through his problem solving process prior to a breakthrough. A correlation is only presumed. The cases in the literature may be learners with similar reactions to the participants in the study.

Persistence is seen illustrated in the reports from the participants as determination to succeed - they stuck to their respective tasks. The cases in the literature illustrate similar qualities of 'stickability'. It is not clarified to what degree of persistence, but, each learner presumably maintained interest until satisfied with the result. Uniformity is presumed.

Resignation illustrates the penultimate stage the eight participants perceived before learning breakthrough. They are each seen to demonstrate that they were satisfied that their preparation was complete and they felt confident. This feature of the occurrence is not addressed from the cases in the literature therefore, a correlation can not be provided.

Diversity of Types specifically addresses the learning outcomes used in the conceptual framework of this study. The researcher did not identify a significant number of comparative learning types from the cases reported in the literature. A degree of correlation may be presumed between some types evident across both areas of research where, in the literature,

Penrose (1991), for example, refers to Poincaré learning to create a new rule for explaining a complete mathematical formula. Such learning outcomes are identified in this study as intellectual skills. Another example may be a cognitive strategy identified in all the cases cited. A correlation is, therefore, illustrated to a limited degree.

Barrier Lifting describes the release from whatever eluded the learners previous to learning breakthrough and did not elude them after the event. The literature provides evidence of similar qualities of release evident with the cases through exploring the feature 'Singular'.

A **Cumulative** finding focuses on the constructive qualities of learning breakthrough reported in the cases in the literature and by the eight participants in this study. A degree of correlation may be seen in the way each learner built on their knowledge and skill to further progress and become more self-actualised and confident with their particular subject.

Reinforcement refers to the way the participants in the study reported rehearsing or practising what was learnt and thus reinforce the learning. The literature, too, provides some evidence of similar behaviour where the learners re-affirmed for themselves what had occurred at the moment of learning breakthrough, such as the cases of Poincaré and Penrose (Penrose 1991) who report rethinking what had occurred.

Developmental refers to the process of change - the steps which provide a developmental sequence to illustrate what the participants incurred before, during and after learning breakthrough to progress with learning. This developmental aspect was not particularly explored in the literature, however, the findings illustrate the same broad sequence of steps before, during and after the event. Although there are no details in the change process the broad steps provide some uniformity with the findings in this study.

Effortless is particularly explored in this study because the learners report an experience which had no apparent recourse to objectives or structure and there was a perceived ease with which they engaged event. From the cases in the literature review, particularly Penrose and Poincaré (Penrose 1991), and Halmos (Albers and Alexanderson's 1984), the experience of a learning breakthrough during a conversation on other matters is

perceived happening without burden. Assuming apparent ease this and the reports in the study indicate, learning by learning breakthrough is seen to be effortless and correlates across the research.

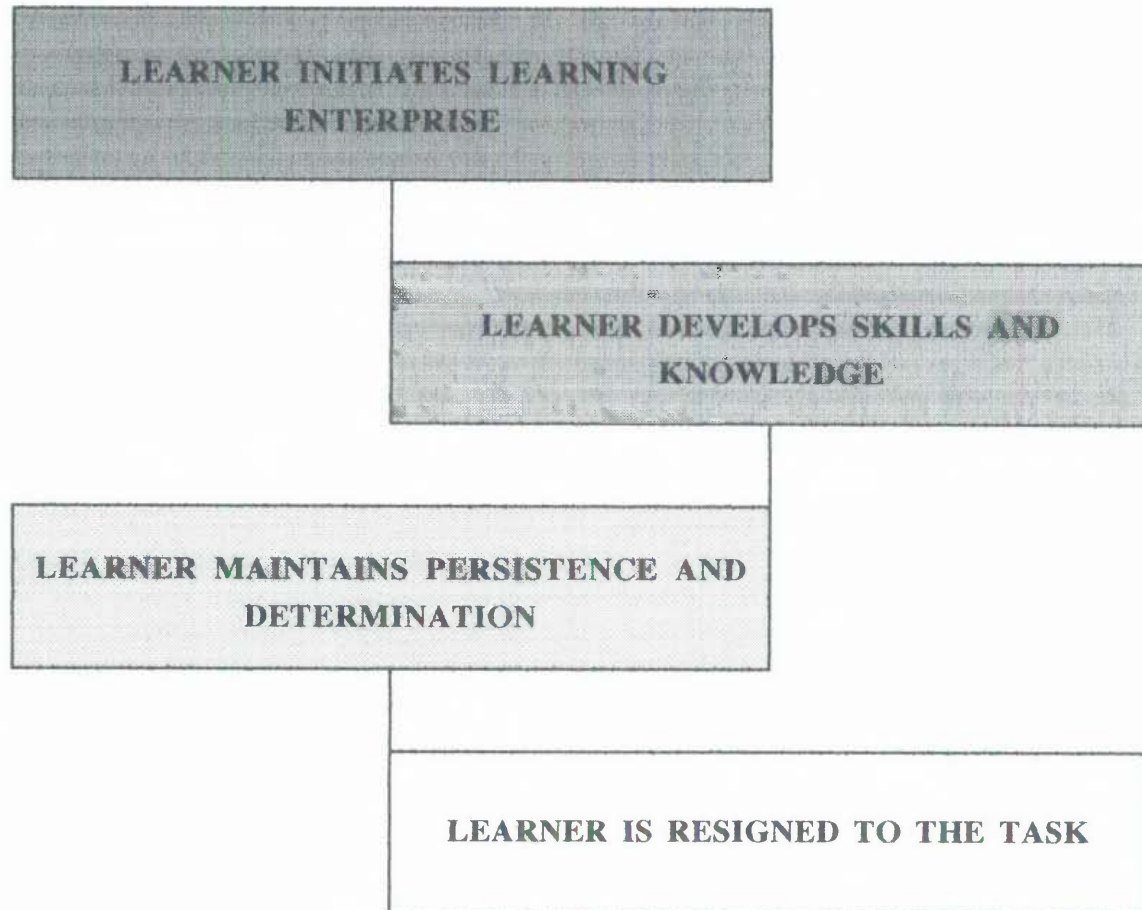
Of the features identified by the researcher to express his perception of his own experience of learning breakthrough, this phenomenon is found by him uniformly related with this study and that reported by the cases in the literature, such as: (a) a single event which lifts specific barriers, (b) a central cognitive process, (c) unpredictable, (d) sudden, (e) transformative and constructive providing lasting knowledge and skill, (f) a pleasurable experience, (g) memorable, (h) intentional or occurring while a learner is actively seeking a goal, (i) a change process, (j) associated with a variety of prior and consequential feelings, (k) associated with a diversity of learning types, and (l) effortless experience. In summation, using a feature perhaps inherent in all these and identified originally by the researcher, the phenomenon is an extraordinary learning experience. For example, the study presents learning breakthrough as a very flexible and notable learning event - it can happen anywhere, to anyone and occur in a variety of learning and social contexts, but, may not happen expectably, even given effective external and internal conditions.

There is a simple educational model which emerges from exploring the features of learning breakthrough. The model is learner centred and could be used as a way of structuring self-managed learning. Figure 1 has been created by the researcher as a way of concluding what has been found to occur with the participants in this study. Presented is a model describing four steps which are recommended for a self-managed educational process. Each step represents a condition and the fourth step can be presumed as the step here in which the learning breakthroughs was reported to occur. The steps are:

- | | |
|--------|---|
| STEP 1 | Initiate the process, that is, make a definite decision to start. |
| STEP 2 | Take an intentional step to understand the problem, subject or topic, develop physical strength as needed or work to change attitudes. |
| STEP 3 | Be determined to reach a solution even when, in the face of seemingly insurmountable barriers, frustrations arise. |
| STEP 4 | Reach a point of resignation. Be satisfied with one's preparation and work with the task while patiently waiting for the unpredictable learning breakthrough. |

Figure 1

EDUCATIONAL MODEL OF THE LEARNING BREAKTHROUGH EXPERIENCE



The four stages through which the learner progresses demonstrates the essential elements reported by the eight participants including the researcher. The model represents the process used by each adult learner who successfully negotiated a learning barrier with learning breakthrough. It is illustrative of the findings in this study.

It is noted that although conditions were right, there was no evidence in any research explored of learning breakthrough being a guaranteed end result. However, in each case both in the literature and the study, the learners individually reached a point just prior to learning breakthrough where their attitude was positive and they were prepared to progress to overcome the barrier(s).

Information for the model came from the eight participants reported in the study. The following discussion examines the findings in support for the

recommendations raised in the final two steps of the model. The two initial steps are generally understood through educational practice and the foregoing discussion, as the last two steps, but, the later are particularly notable.

The learners were assisted in the development of knowledge and skills. In Jack and Warrens' cases teachers and tutors were heavily involved. Other learners such as Coral, Gary and Melinda had no teacher, in Norm's case he reported a series of teachers and Tina had personal tutoring. There was no apparent pattern of external or artificial help, giving rise to the notion that something else was involved to meet the conditions for learning breakthrough. There was something within the learner as the personal behaviour attests. Having outside guidance, it seems, is not always a requisite, but teachers may played their part when they were involved. Other issues too, like being relaxed and calm were not a prerequisite for breakthrough, although such emotions played their part in some cases. If any influence is to be noted as providing a pattern of pre-breakthrough requirements, then determination is seen to occur in all the eight cases reported including the researcher. Even in the seemingly casual and relaxed experiences of Poincaré, Penrose, and Halmos, their reports indicate, in the broader experience, attributes of determination and motivation. The point is made here that the internal conditions for the occurrence of learning breakthrough rest with the learner.

Some confirmed it, others inferred it, that learning breakthrough was different from other learning experience because of its peculiar memorable way of terminating a struggle. Learning breakthrough was generally seen to be an encounter at the end of a personal struggle, personal because it applied to them only and struggle with a problem because something eluded them.

Emotions are a note worthy issue to emerge from this study. Firstly, determination and motivation helped the learners in the lead up to breakthrough. Secondly, emotions were seen to signal problems and a change was needed. Thirdly, emotions made breakthrough a memorable learning event with the consequence of the learner being able to reflect on their own learning processes.

What was found from the literature to establish the final two steps in the model is the learners' ability to rest in the knowledge that they were

prepared to learn, even though, as the majority report, emotions varied. Examples of readiness were expressed by participants in different ways and perceived here as follows.

Coral felt ready. She says: *.. I thought I would give this a go.*

Gary reports having built a structure ready for the pieces to link to his theory.

Jack felt at ease with his teacher.

Melinda had gathered all the necessary information and was in a quiet situation at home.

Neil had practised talking to strangers and felt ready to talk to the Motel manager.

Norm had accepted new information as relevant and was participating in activities.

Tina had developed the strength of voice and was confident in her preparation.

Warren had confidence in his preparation for writing intuitively.

In conclusion, the learners were seen to reach the final stage in the model, resigned to their tasks of overcoming their respective barriers when, for them, they experienced a learning breakthrough.

This next discussion regards the effects of learning breakthrough.

It was also discovered that learning breakthrough involved physical and technical skills, attitudes, personality, and higher-order intellectual skills. Learning breakthrough has the potential for impacting on adults in any area of learning, vocational, technical, and recreational. Claims to learning breakthrough occurring in only one sector of education is not founded from this research.

It would be reasonable to think that as a basic learning occurrence as natural as learning itself, learning breakthrough would be a common occurrence. There is no one simple answer why the research participants identified a particular event and say that it was extraordinary. Learning breakthroughs possibly happen often. However, from the findings, only some learning instances become noteworthy and are described by learners as a learning breakthrough. An explanation for this noteworthy is drawn from examining emotional aspects of the experience and transformations which are seen to occur. Arguably from the findings, without these two perceived differences, (emotional and transformative aspects), learning may pass without being remembered and hence, it is not described by people as learning breakthrough.

This study used self reporting for collecting data. The success of this method was helped by the emotional aspect perceived earlier as being associated with learning breakthrough.

The emotions as initial frustrations with the problem then joy and elation at breakthrough, inevitably played their part in isolating this experience for the learner to remember as compared with other learning experiences. The part seen to be played by feelings is perhaps strategic for the eight learners because it was seen to help their memory of the event. When they were asked to focus and reflect upon this particular event and describe what they perceived as their learning breakthrough experience they remembered detail, but, in the majority of reports the participants remembered associated feelings and the detail was their explanation for the feeling. With the few remaining participants this reporting was reversed with detail of the event before remembering the associated feeling. From using self-reporting as a method for collecting data, the participants remembered the occasion with ease and perceptive clarity with the inevitable revelation of feelings mostly remembered first.

There is no evidence to suggest that the phenomenon is restrictive. It can conceivably occur to the same people in another area of interest. If these same people were to repeat the conditions as applied for one breakthrough, evidence from the common features in the broader context of breakthrough suggests that another learning breakthrough could conceivably occur in another learning situation. For example, the conditions, reflecting on Tina's case, could work for her again. That is, if she was determined to succeed, had some prior learning, prepared the physical and mental attributes, became involved in an environment deliberately arranged for a specific purpose knew what to look for in the environs to provide the right cues, and finally, have the internal fortitude to try something new, learning breakthrough may happen again. Whether for the research participants only or the same conditions for someone else, and the experience occurs, is not conclusive, but, such a proposition could give rise to further study.

A concluding comment for other researchers who may consider exploring learning breakthrough is that to find evidence of the phenomenon there is apparently no limit to the sample for study.

It was found that each participant came from a cross section of society having diverse backgrounds, age and gender.

Explicit Recommendations

The following recommendations for adult learning practice - directed both to adult learners and educationalists - are drawn from the findings from this study.

ADULT EDUCATIONAL PRACTICE (Teachers and Learners)

1. **Process:** Teachers, tutors, mentors, or facilitators of learning should pay particular attention to the processes of learning as well as the outcomes. The learning outcomes were not seen to appear until the learner reached the point of using their internal processes in new ways. They then demonstrated competence. The eight participants in the study were seen to make progress when they utilised their basic abilities of internally directed process types of association, analysis, recognition, recall, discernment and mnemonics.
2. **The cognitive strategies that may trigger learning breakthrough:** Teachers should design the teaching or learning approach to recognise the importance of developing cognitive strategies - develop learner's ability to think through issues. The adult learners in this study were seen to manipulate their ideas, knowledge and values to the point where they used their thinking processes in a new way and experienced a learning breakthrough. This in turn allowed them to develop further their potential. The learning breakthrough was seen here to be a cognitive strategy used by the learners in a new way through one or many processes of association, recognition, discernment, or mnemonics to each solve their own particular novel problem.
3. **Give learners hope and encouragement.** Teachers and learners should recognise that major barriers arise, but, they can be and are frequently rapidly overcome. Negative emotions can

overcome. Success in this regard was seen to come from determination, demystifying the insurmountable barriers by working through the problem a small step at a time, and keep each step simple by using basic forms of cognition and verbal information, such as, association, recognition, recall, clarifying, rehearsing, labelling names and concepts. Negative barriers can be opportunities to change.

4. **Let it happen:** Educators and learners alike should recognise the importance of space in the achievement of learning breakthrough. Breakthroughs are seen to occur in this study under a range of conditions, though not strictly in accordance with any predetermined learning environment. Learning breakthroughs seem to be dependent on the learner and how they are feeling at the time. Learners were seen to develop at their pace whether they were involved in directed or independent learning situations. There was an element of freedom of choice for the adult learners in the study to relax into their tasks, or determined by them or someone providing guidance.
5. **Create a supportive climate for learning.** It is important that educators understand and act on the need to create a learning climate that is free of threats, that is open to alternative possibilities that gives the learner room to opt out or become involved.

It was seen in the study how educators and the learners themselves made learning more emotionally stimulating to give them a chance, such as , building confidence, self-esteem and creating incentives. In self-directed learning, too, learners may pay attention to, and create for themselves, positive emotions while learning - relaxing into their tasks. This is not suggesting a recipe to be applied to all learning situations and expect a learning breakthrough. Each must be taken and assessed on their own merit. As a possible pre-condition in the formal or non-formal setting the learning activity could, for example, include the means for the learner to get away or to find their personal space or place where nobody or no external interference will intercede and distract the learner - an effective strategy perhaps when barriers arise. The learner may prefer to get away, go for a walk, go

jogging, find a quiet place or whatever is the individual's perceived place of personal space. Gary and Melinda, are two adult learners in the study who demonstrated the strategy. Present the conditions for learning to happen on its own accord - facilitate the learner as well as the environment.

6. **Encourage learners to assume an active role in their own learning:** Teachers should particularly encourage learners to take an active role in meeting their goals - seeing goals through to their desired end. This recommendation is suggested as being pivotal to learning breakthrough because the learners in the study maintained determination and were focused on the goal which they achieved.

FURTHER RESEARCH

There is a need for further study over a wider range of individuals and experiences. One group of learners is primary school age children. It may be presumed that other groups of people experience learning breakthrough, but, are the circumstances, features and characteristics similar to the finding here? The research in this study does not provide such evidence.

In another instance, further research may benefit education and the learner knowing if a learner goes on to experience other breakthroughs and if there is a relationship and what benefit are there for educational practice and the individual learner?

Final Comment

In conclusion, other research and the research study has confirmed the researcher's original view of what set apart learning breakthrough for him was seen by others also to be extraordinary, unexpected when it occurs, sudden, an unconscious internal process, breaker of barriers in learning, transformative with long lasting results in skills and/or knowledge, and associated with positive emotions.

Footnote

Chapter 3 The Conceptual Framework pages 45 and 46

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)

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