LEARNING STYLE, MODAL PREFERENCE & THE SPACING EFFECT IN AN ONLINE PROJECT MANAGEMENT TRAINING PROGRAMME

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Copyright Statement

ABSTRACT

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Constant and continued up-grade of skills and qualifications is imperative in a knowledge society (David & Foray 2003, OECD 2007) and central to Continued Professional Development (CPD) programmes in most organisations. However identifying and using effective (maximise retention / recall) and efficient (minimise time to learn) learning practices is often a challenge.

This thesis reports the findings of a longitudinal study consisting of naturalistic observations of a real-life adult online learning environment for project management (PRINCE2®) based in the UK. The primary research question sought to explore, the impact of modality preferences, learning/cognitive styles and patterns of usage on course completion, time spent and time to completion.

The first phase collected data over 14 months following the launch of the new online project management learning system. Some changes were identified and incorporated before collecting additional data. The second phase collected data over the next 14 months. The interplay between Inter Session Interval, Study Duration, Frequency of Usage and its impact on Time Spent & Time to Completion are further explored using the concept of the Spacing Effect. The Spacing Effect is a robust phenomenon that suggests that the retention / recall of learning improve when presentations are spaced as opposed to massed (Toppino et al., 2002).

The thesis concludes by summarising the observations with respect to the research questions, across the two phases of study and the further analysis of the Spacing Effect. The contributions of this research to online project management training are discussed in the form of implications and recommendations for future work. The outcomes of the study have informed and will continue to inform the on-going online learning development at the partner organisation.

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DECLARATION

I declare that the thesis hereby submitted for the degree of Masters of Philosophy at the Bournemouth University is my own work produced as a Part-time post graduate researcher and has not been previously submitted at any other university or for any other degree.

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CHAPTER 1 – Introduction and Background

We live in a knowledge economy; a knowledge society continuously requires higher levels of skills and qualifications to fill the same jobs (David & Foray 2003, OECD 2007). US President Barack Obama said on skills "Not only does that risk our leadership as a nation, it consigns millions of Americans to a lesser future," [Reuters 13-Mar-2010]. Lord Sandy Leitch's Review of skills report (2006) outlines UK's ambition to become a world leader in skills by 2020. Independent policy agencies such as the EU and OECD continue to assert the importance of education, skills, CPD and life long learning (OECD 2006, 2007; EU 2007, 2009; BIS 2009).

The learning needs of individuals are on-going and continuous throughout the working life, as labour markets demand knowledge and skills that require regular updates (David & Foray, 2003). Volery and Lord (2000) point to the capacity constraints and resource limitations that can be overcome through the implementation of e-Learning. DfES (2008, 2010) attribute flexibility and pervasiveness as key drivers for e-Learning to have greater strategic social influence to support the learning requirements of the UK.

In this context an initiative was started to explore avenues to scale up the project management capabilities across the local strategic partnership of public authorities (led by Teignbridge District Council) based in the south west of England. A web based e-Learning application (PRINCE2® Passport from SPOCE) in PRINCE2® Project management was identified as an efficient, scalable and (cost / time effective) practical solution. The traditional model entails 5 days of intensive instructor-led classroom training typically costing around £1200 - £2000 per delegate. (PRINCE2® is a methodology in project management. It is a best practice in project management and a de-facto standard in the UK. The industry provides for 2 levels of certifications in the method, foundation and practitioner.)

The learning application is hosted at www.prince2online.org.uk and is made available to the public authorities across the country. The project was part funded by ODPM's (Office

of the Deputy Prime Minister, now called Department of Communities and Local Government) eInnovation scheme grant.

This research has been conducted in collaboration with SPOCE. SPOCE Project Management Ltd. is an accredited training organisation specialising in training individuals to become certified in OGC (Office of Government Commerce) best management practice methods. Methods covered include, PRINCE2 project management, MSP programme management and M_o_R management of risk. SPOCE offers a public schedule of instructor led classroom training events across the UK as well as e-learning options. Each training event ends with delegates taking the certification exams. The e-learning application (PRINCE2® Passport) for training in PRINCE2 project management is the package on which this research is based.

The underlying PRINCE2® Passport e-Learning application was designed and developed as a result of a successful KTP (Knowledge Transfer Partnership – SPOCE, Bournemouth University and the DTI) project. The author is a full time employee of SPOCE and between 2004 and 2006 the author was a KTP Associate. The MPhil research project followed on immediately from the KTP project (where the learning application was developed at SPOCE) and at this stage the author enrolled as a part-time post graduate researcher (2007 onwards) at Bournemouth University. During the time of the MPhil (the learning application was implemented at www.prince2online.org.uk) the research was designed to observe the learning environment and the experiences of the learners. It therefore builds on and benefits from the insights, experience and work completed during the previous KTP project.

The MPhil research project presented a unique opportunity to observe a real-time adult e-Learning environment in a naturalistic real world setting. It was observed over a period of 3 years, to understand the trends and patterns of usage and its implications on the learning process and outcome. In particular, the primary research question seeks to explore if modality preferences, learning styles and pattern of usage have a bearing on online project management training/e-Learning Completion, Time Spent and Time to Completion. The outcomes of the study are expected to feed into the future/on-going e-Learning development at the partner organisation (SPOCE).

This thesis reports on a longitudinal study over 3 years, covering two distinct phases or data points. The study uses a combination of research methods (mixed).

The first phase collected data, 14 months from the launch of the project. Some changes were proposed and incorporated at this stage to collect additional information. The second phase collected data 28 months from the start of the project. The interplay between Average Time between logins, Average study time, frequency of usage and its impact on Total Time spent & Time to Completion are further explored using the concept of the Spacing Effect (Retention / Recall of repeated items improves when presentations are spaced).

The Spacing Effect is a robust phenomenon that has been observed in explicit memory tasks such as free recall, recognition, cued-recall and frequency estimation (Mammarella et al. 2004) studied most commonly in the foreign language learning and advertising fields. Although there is no data of this phenomenon in adult e-Learning, Dempster (1987) describes the Spacing Effect as uncommonly reliable, remarkably robust and observed in virtually every standard experimental paradigm.

This thesis reviews the theoretical accounts (life-long learning, learning theories, instruction design, adult learning, learning / cognitive styles & the Spacing Effect) in chapter 2. The method and the research questions are presented in chapter 3. The analysis of the data from the Phase 1, Phase 2 and the Spacing Effect observations are also presented in chapter 3. In chapter 4 the findings on the research questions are analysed and discussed. The findings are summarised in chapter 5 and the potential implications for the industry and future research work are highlighted.

The project has since then also won an award for 'Best in Category – e-Learning' from the ODPM.

CHAPTER 2 - Literature Review

This chapter explores and reviews the literature around learning and the adult learner. It comprises five sections; the motivations for continued learning are explored in the section 2.1. The Learning theory section 2.2 discusses the key learning theories and their impact on learning systems. The models for developing learning instruction are reviewed in the section 2.3 on Instruction Design. The key attributes specific to adult learners are explored using Andragogy in the section 2.4 and finally the learner differences in terms of modality preference, learning/cognitive style are explored in the section 2.5 on Learning and Cognitive styles.

2.1 Lifelong Learning & Continuing Professional Development

The advent of knowledge society and the associated constant and rapid social, economic and political change are cited as the key drivers for lifelong learning (CPD Institute, 2010). Sadler-Smith, et al (2000) attribute a) survival - remain competent and continue as valued and productive members of the organisation, b) maintenance - update and improve skills/competence and c) mobility - enhance mobility in the labour market, as the underlying motivations.

For many professionals this commitment to lifelong learning is manifested by an active involvement in Continuing Professional Development (CPD). It is also referred to as Continuing Education (CE), Continuing Education and Training (CET), Continuing Professional Education (CPE), Continuing Vocational Training (CVT), Post Qualification Development (PQD).

The Certified Institute of Personnel and Development (CIPD), UK defines CPD as a 'constant updating of professional knowledge throughout one's working life by means of systematic, on-going, self-directed learning'. The key features are a) Continuous – throughout the practitioners working life, b) Professional / organisational focused, c) Structured – systematic maintenance and improvement, and Self-directed.

A wide range of terms surround the concept of self-direction: autonomy, learner-centred, flexible learning, self-study, distance learning, etc. Knowles (1990), described self-direction as the point at which a person becomes an adult, that point at which he/she perceives themselves to be self-directing. Candy (1987), distinguished self-direction from autonomy as surrendering some measure of control over the teaching situation; i. e. exercising a rational choice between dependence (being directed) and independence (directing oneself).

CPD is also increasingly regarded as a primary duty of membership to professional bodies or communities of practice. In most instances, the undertaking of CPD is regarded as obligatory – based on trust. However, some bodies (for instance General Dental Council, The Institute of Arbitrators) treat it as mandatory and the records may be policed. A survey of the UK professional bodies published by 'Training & Coaching Today' (2008) showed that CPD is now mandatory for 50% of members of professional bodies in the UK. Similarly, a report by Securities & Investment Institute (2008), UK titled 'Trends in Continuing Professional Development.' showed 83% of the 18 firms & 1200 individuals surveyed were in favour of compulsory CPD (up 63% from 2004).

2.2 Learning Theory

This section discusses the key learning theories of Behaviourism, Cognitivism, Constructivism and Humanism and explores their impact on the design and implementation of learning systems.

2.2.1 Behaviourism

Behaviourism is based on the premise/view that psychology should explore behaviour of human beings rather than mental phenomena and therefore attempts to provide behavioural explanations for a broad range of cognitive phenomena (Skinner 1968, 1971; Bechtel et al. 1998).

Behaviour theorists describe learning as an act of acquiring new behaviour. Changes in behaviour are a function of an individual's response to events (stimuli) that occur in the environment. A response produces a consequence (eg. kicking a football, or solving a Sudoku). When a particular Stimulus-Response (S-R) pattern is reinforced (rewarded), the individual is conditioned to respond (Skinner 1977).

The behaviourist learner is viewed as a passive recipient of knowledge through rehearsal and correction - positive & negative reinforcement (Tuckey 1992). The role of the teacher being to reinforce desired behaviour. The measure of learning is estimated by the probability of a given stimulus producing the correct response by the frequency with which it produces the correct response.

Behaviorism is used by teachers who reward or punish student behaviour. It's positive and negative reinforcement techniques have been reported to be effective in treatments of human dis-orders such as autism and antisocial behaviour (Autism and Asperger syndrome - Frith, 1991). Their benefits when used to support adult learning is however unclear, as adult learners may be more resistant to positive or negative reinforcers to achieve a desired behavioural outcome.

In terms of impact and implementation on a learning system, behaviourism expects that the learning system has a predetermined view of all the skills that are required for the student to learn and presents them in a sequential manner and finally reinforce student behaviour that it perceives to be correct.

2.2.2 Cognitivism

Cognitivism moves from the passive view of the learning adopted by behaviourism and makes mental processes the primary object of study and attempts to explore and model processes of the learner during the learning process.

Cognitivists (Anderson 1996; Bruner 1985; Piaget 1990; Gagne 1987) suggest that there is an external reality and an internal representation of that reality. Knowledge is seen as symbolic, mental constructs in the minds of the learners, and learning becomes a process of committing these symbolic representations to memory to be processed.

Bruner (1960,1985) enumerates the following processes the mind goes through when it receives information :

- Information is selectively received by "Attention".
- This information is then integrated into the inherent order of memory via a process of "Encoding".
- Information becomes knowledge when it is integrated into the existing cognitive structure (Piaget 1985, suggests two main concepts here, organisation (or equilibrium) and adaptations which entails assimilation and accommodation, where new information is shaped to fit with the learner's existing knowledge, and existing knowledge is itself modified to accommodate the new information.).
- The knowledge can then be remembered in the process of "Retrieval".

The emphasis on teaching and learning strategies focuses on techniques to enhance the attention, encoding and retrieval of knowledge (These concepts are explored further using the Spacing Effect phenomenon in later sections (3.4 & 4.3)). Newby (1996)

suggested careful organisation of content and the use of analogies/mnemonics to achieve this.

The cognitive approach and the resulting theories use the information-processing models/theories (Broadbent 1958). We can relate human information-processing to how the computers process information: receive, store and retrieve.

Looking at this from the implementation perspective, the role of a learning system is therefore to present a view of the information to be learned (accurate representation of the external world) and then keep at it until understood. Similar to behaviourism except cognitivism is also concerned with the active mental processes of the learner. This change of focus seems to build on the existing (behaviourist) instruction design to take account of the learners' previous knowledge and then scaffolds towards the new learning objective. It does not presume that learners have the same past experience or learn in the same manner. Saettler (1990) suggests breaking the lesson down into units that move from simple to complex to build on the learner's previous schema.

2.2.3 Constructivism

Constructivism builds on the attention, encoding and retrieval of knowledge processes from cognitivism, but maintains that there is no single accurate representation of the world, only interpretations of experience. Knowledge is described as a collection of concepts which fit with the experience of the individual (Tuckey, 1992). Learners actively take knowledge, connect it to previously assimilated knowledge and make it their own by constructing their own interpretation (Cheek, 1992).

The social constructivist's (situated perspective) view of learning focuses on the way knowledge is distributed socially. Knowledge is seen as situated in the practices of communities; the outcomes of learning involve the abilities of the individuals to participate in those practices successfully (Lave & Wenger 1991, Mayes & Freitas 2004). Kukla (2000) argues that reality is constructed by our own activities and that people, together as members of a society, invent the properties of the world. Learners compare

their version of the truth with that of the instructor and fellow learners in order to get to a new, socially tested version of truth.

Constructivists encourage learners to construct their own understanding, based on their reality, and then validate their new perspectives through social negotiation. The teacher/instructor therefore is removed from their central role of transmitting information to that of a guide to encourage learners to construct their own understanding. Collaboration, interaction, discussion and reflection collectively facilitate the acquisition and assimilation of knowledge.

Ertmer & Newby (1993) enumerate the following constructivist strategies –

1) Cognitive apprenticeships - where experts model and coach a learner toward expert performance.
2) Presenting multiple perspectives and using collaborative learning to develop and share alternative views.
3) Social negotiation - so debate and discussion can take place.
4) Using examples / scenarios as realistic illustrations.
5) Reflective awareness

2.2.4 Humanism

Educational Humanism is focused on the human freedom, motivation, dignity, potential and draws on the works of humanistic psychologists such as Carl Rogers & Abraham Maslow and the study of Andragogy (‘the art and science of helping adults learn’ Andrew Knowles, 1980) and therefore particularly relevant to our target audience. A central assumption of humanism (Huitt, 2001), is that people act with intentionality and values. This is in contrast to the behaviourist notion that all behaviour is the result of the application of consequences (operant conditioning) and the cognitive psychologist belief that the discovering knowledge or constructing meaning is central to learning.

Humanism begins with the theory that learning occurs primarily by reflecting on personal experience. The role of instruction is not to put anything in the mind or repertoire of the learner, but to extract lessons from the learner's insights and experience (Rogers 2003).

Learning is about gaining new insights into previous experiences; the role of the instructor is to help learners supplement experiences with new opportunities. The goal of Instruction is to stimulate questions that help learner make new connections and uncover what they already know (Huitt, 2001).

Rogers (1994) believed that the desire to learn must come from intrinsic motivation, created by the need for personal growth and fulfilment. He stresses that learners must feel comfortable with the learning environment and the flow of topics.

"The way we feel about a program influences our commitment to it. If we feel secure, respected, esteemed, and empowered, we're likely to make a strong effort. If we feel threatened, anxious, hostile, or demeaned, we're likely to resist." [Rogers 1994, p 132]

Humanism has little structure, respects individual differences and the goal is to develop self-actualised individuals in a cooperative, supportive environment. The learning occurs primarily through reflection on personal experience and as a result of intrinsic motivation. Some of the Humanistic methods/strategies proposed are inductive discussion, individual/group projects, debriefing sessions, action planning, self-assessment, visualisation and guided reflection.

2.2.5 Analysis of the Learning Theories

As we move along the Behavioural → Cognitive → Constructive → Humanist theories the focus shifts from teaching to learning. The strategies move from passive transfer of facts and routines to active participation and application of ideas and problems.

Whilst cognitivists, constructivists, and humanists each view learners as active participants, constructivists and humanists regard learners as more than active processors. They believe that learners must elaborate and interpret information.

The following table summaries the defining terms associated with each theory –

Theory	Behaviourism	Cognitivism	Constructivism	Humanism
Theorists	Skinner, Thorndike, Watson	Piaget, Bruner, Gagne	Piaget, Papert, Lave & Wenger, Salomon	Rogers, Maslow, Knowles
Role of Instructor	Behaviour Modifier	Prompter, Disseminator of information	Dialogue, facilitator, prompter, challenger	Facilitator, Coach, Listener, Partner
Level of Structure	High level	Moderate level	Low Level	Varying level
Processing Required	Low conceptual levels	Moderate conceptual levels	High conceptual levels	High conceptual levels

Combined from Dubin & Okun (1973), Merriam & Caffarella (1991), and Smith (1999)

Table 1: Comparative summary of defining terms associated with Learning Theories

Ertmer & Newby (1993) argue that the critical question is not, 'Which is the best theory?' but rather, which theory is most effective in fostering mastery of specific tasks by individual learners. What might be effective when we're novice learners, meeting complex bodies of information for the first time, may not be effective, efficient or stimulating for learners who are familiar with the content.

Similarly, the instruction approach could be tailored based on the level of cognitive processing required. For Instance, Behaviourism might be suitable for tasks requiring low-level processing (relating this to Knowledge & Comprehension - Blooms Taxanomy). Cognitive strategies fit with subjects that require more advanced processing (relating this to Application, Analysis, Synthesis and Evaluation - Blooms Taxonomy). Tasks that involve high-levels of processing are frequently learned best with humanist strategies. Similarly, adult audiences might be a bit more receptive to humanist approaches based on andragogic principles.

2.3 Instructional Design / Instructional Systems Design Models

Instructional Design or Instructional Systems Design (ID/ISD) is the practice of creating instructional tools and content to help facilitate effective learning. The process entails identifying the current state and needs of the learner, defining the end goal of instruction, and creating 'interventions' to assist in the transition. The process is informed by pedagogically tested theories of learning.

Learning theories play a key role in the design of instructional materials and help shape and define the outcome of the instructional materials. The key models in instruction design will be reviewed in this section.

2.3.1 ADDIE Model

The ADDIE model also called SAT (Systems Approach to Training) takes a systems approach to instruction design (Clark, 2004) and consists of five phases:

- Analyse - analyse learner characteristics, task to be learned, etc.
- Design - develop learning objectives, choose an instructional approach
- Develop - create instructional or training materials
- Implement - deliver or distribute the instructional materials
- Evaluate - make sure the materials achieved the desired goals

ADDIE is by far the most influential of the instructional models and forms a basis of many other models (ASSURE, Rapid Prototyping, etc). Some of the criticisms of the ADDIE model are that it is sequential, linear, ideal for large organisations / projects, behavioural (Clark, 2004; Clark, 2002; Dick & Carey 2001, 2008).

2.3.2 Gagne's Events of Instruction

Based on the Cognitive learning theory, Gagne (1987) developed what he called the nine events of instruction to influence the process of learning effectively and efficiently. The table below shows the nine events and the learning process that it relates to -

No.	Events	Process of Learning
1	Stimulation to gain attention	To ensure the reception of stimuli
2	Informing the learner of the learning objective	To establish appropriate expectancies.
3	Reminding learners of previously learned content	For retrieval from long-term memory
4	Clear and distinctive presentation of material	To ensure selective perception
5	Guidance of learning	By suitable semantic encoding
6	Eliciting performance	Involving response generation
7	Providing feedback	About performance
8	Assessing the performance	Involving additional response feedback occasions
9	Arranging variety of practice	To aid future retrieval and transfer

Table 2: Gagne's nine instruction events and the learning process it relates to.

These events (table 2) can be translated into specific instructional tactics/strategies that can then be implemented in any teaching-learning environment in order to best achieve the desired performance or learning outcome. Gagne's nine events were one of the key elements of SPOCE's instruction design approach (covered in the methods section) for developing the learning content.

2.3.3 Dick and Carey's Model

Dick and Carey's (2008) System Approach Model addresses instruction as an entire system, focusing on the interrelationship between context, content, learning and instruction. According to Dick and Carey (2008), Components such as the instructor, learners, materials, instructional activities, delivery system, and learning and performance environments interact with each other and work together to bring about the desired student learning outcomes.

The components of the model are -

- Identify Instructional Goal(s)
- Conduct Instructional Analysis
- Analyse Learners and Contexts
- Write Performance Objectives
- Develop Assessment Instruments
- Develop Instructional Strategy
- Develop and Select Instructional Materials
- Design and Conduct Formative Evaluation of Instruction
- Revise Instruction
- Design and Conduct Summative Evaluation

The components of Dick and Carey's model are executed iteratively and in parallel as opposed to linearly in the ADDIE model. The model however may be too rigid and cumbersome for the average design process, as supported by Clark (2004).

2.3.4 ARCS Model of Motivational Design

According to ARCS Model of Motivational Design (Keller, 1987), there are four steps for promoting and sustaining motivation in the learning process: Attention, Relevance, Confidence, and Satisfaction (ARCS).

ARCS address motivation, a key element often overlooked in instructional strategy. This model is not intended to stand apart as a separate system for instructional design, but can be incorporated within other models such as ADDIE, Gagne's events of instruction, Dick & Carey's System Approach Model.

2.3.5 Evaluation of Instruction Design Models

Although ADDIE is a popular approach to developing learning content, its ability to improve the learning however is uncertain. As Morrison (2003) states - if you put garbage in, you get garbage out. The ADDIE model does not look at the relevance of the subject to the learner. Keller's ARCS model based on motivation does address relevance however is lacking in other areas of instruction design.

According to Thissen (2003), first there is emotion, after that comes cognition. Similarly, Rossett, & Schafer (2008), suggest a real instructor affects the students emotionally. However emotion does not seem to be of any particular prominence amongst the ID models.

Clearly, the current instructional design models are by no means perfect. Dick & Carey (2001) described the initial formation of their influential model as a process of applying a diverse body of research and thinking of the times to the task of creating instructional products. It was a process of synthesis. The validation of the model came through repeated use rather than empirical study. As new understandings of learning and instruction become available and accepted, existing ID models are refined, enhanced and combined to take into account such developments and changes (Tracey & Richey, 2007).

Morrison proposed his own ID architecture that incorporated elements of Gagné, Reigeluth, Bloom and Merrill’s research along with the ADDIE and ARCS models and he commented: “Emotion comes from relevance and resonance. As an instructional designer, the learner will ‘go with you’ if you strike a chord with them.” (Morrison 2003, p86)

Similarly Tracey & Richey (2007), propose an overlay approach combining ADDIE with Dick & Carey's ID model whilst developing a Multiple Intelligence ID model based on Gardner's theory of multiple intelligences.

2.4 Adult Learners & Andragogy

Knowles' (1980) theory of Andragogy is an attempt to develop a theory specifically for adult learning. Knowles emphasises that adults are self-directed and expect to take responsibility for decisions. Adult learning programs therefore benefit from accommodating these fundamental premises.

The term Andragogy ('the art and science of helping adults learn') offers an adaptation of pedagogy and suggests that five key issues be considered and addressed in formal learning:

- The need to know — Adult learners need to know why they need to learn something before undertaking to learn it.
- Learner self-concept — Adults need to be responsible for their own decisions and to be treated as capable of self-direction
- Role of learners' experience — Experience (including mistakes) provides the basis for learning activities.
- Readiness to learn — Adults are most interested in learning subjects that have immediate relevance to their job or personal life.
- Orientation to learning — Adult learning is problem-centered rather than content-oriented.

Pedagogy (particularly for the under 16) and andragogy represent the ends of a spectrum that range from teacher-directed to learner-directed learning. Atherton (2005) relates andragogy to situated learning / social constructivism, however set in less formal settings. Kessels & Poell (2004) suggest that andragogy (along with social capital

theory, Portes 1998) has the potential to transform the traditional workplace into a conducive learning environment and emphasise the importance of social networks, partnerships, collaboration, interaction, and knowledge sharing in this process.

In practical terms, andragogy means that instruction for adults needs to focus more on the process and less on the content being taught. Instructors adopt a role of a facilitator as opposed to a lecturer/teacher/grader. Instruction strategies such as case studies, role playing, simulations, and self-evaluation are reported to be most effective (Merriam, et al 1999).

2.5 Learning and Cognitive Styles

Mesick (1976) defines learning styles as *"characteristic modes of perceiving, remembering, thinking, problem solving and decision making." [p198]*
The 'Onion Model' (Curry, 1983) suggests that the learning style and cognitive style constructs may be grouped into three layers resembling the skin of an onion. Remote from external influences and stable over time is the 'central personality' dimension forming the onions core. Overlaying this core are 'cognitive personality style' - relatively permanent and stable characteristics, 'information processing style' - relatively stable set of responses to acquiring and assimilating information in a given learning situation (measured by instruments such as Cognitive Style Index - Allinson and Hayes, (1996) or Kolbs Learning Style Inventory) and finally the outer layer of the onion representing behavioural manifestations of the interaction between the inner layers and the external environment expressed as a preference for particular type of teaching and learning methods (VARK – Visual, Aural, Read/Write, Kinesthetic, Fleming 2005).

The learning preferences and styles of a learner have been reported to be a distinctive and distinguishing feature of a learner. Hayes & Allinson, (1996) and Sadler-Smith, (1999); suggest that matching instruction with students learning style improves learning performance and motivation. The ability to identify and adapt to a learner's learning style therefore might provide powerful tools to enhance (efficient and effective) the learning process.

Coffield et al. (2004) highlights the lack of evidence from longitudinal studies of stylistic similarities and differences. The outer layer is observed later in the study using a Modality preference inventory, followed by the Cognitive style inventory for the next layer.

CHAPTER 3 – Empirical Research

This chapter reports on the research conducted. The first section explores the method used and section 3.2 & 3.3 report on each of the two phases of the study. The final section, 3.4 reports on further investigation of the Spacing Effect.

3.1 METHOD

This is a longitudinal study of the PRINCE2® online training program. The study uses a combination of research methods. The methodology is also informed by previous experience within the industry / project / user base and further evolved over the course of the two data collection phases.

The pre-learning questionnaire (discussed later in 3.1.5) used in the quantitative study was first piloted on the first batch of users. This was followed by a qualitative semi-structured face-to-face interview with the participants to explore and clarify motivations for enrolling and key drivers that were specific to their work and learning environments. These findings were then used to revise the pre-learning questionnaire and then incorporated into the Learning Management System for use in the quantitative study. The definition of core and non-core working hours; progress-group categorisations which are used in the data analysis came through on-going interactions in the form of regular meetings with the stakeholders.

The background research on the learning environment and support systems was collected through interviews, discussions and interactions with learners, line-managers, mentors and learning champions during the project. The quantitative data on the learners' usage, progress, pattern, pre-learning questionnaire, VARK & CSI inventory were collated from the underlying Learning Management System.

Various other alternative research approaches were considered at the outset, such as the possibility of a qualitative structured interview with all the learners. However, the sample are busy working professionals, their availability for a structured interview was a constraint. Similarly a controlled study using students as learners was an option. However a controlled lab is not a natural environment and the data could therefore not be generalised to a real working environment. The opportunity to observe adult learning in a real-life learning environment was identified as most appropriate to achieve the research aims.

The research was divided into two phases; the first phase covers the data point 14 months after the launch of the program and the second phase covers the data collected 28 months from the start of the program.

3.1.1 Learning Design

3.1.1.1 Instruction Design & Objective

The learning subject matter is based on PRINCE2® Project Management. It is a best practice in project management and a defacto standard in the public sector (UK). This method provides for 2 levels of certification/qualification, Foundation *(Blooms Knowledge & Comprehension)* and Practitioner *(Blooms - Application, Analysis & Evaluation)*. The learning content is accredited for both foundation and practitioner level of study and recommends 20 hrs of study for foundation level and 40 hours for practitioner level. The objective of the underlying project was to scale up project management capabilities to the foundation level; progress to practitioner level was optional. A small number of users (four) had progressed to practitioner level; these users have been excluded from the study to ensure that the base learning outcome/objectives of the data-set remain the same.

SPOCE's instruction design approach combines elements of various ID systems such as ADDIE, ARCS, Gagne and theories of adult learning, with a key focus on iterative design

to incorporate ongoing feedback from various stakeholders (learners, trainers, accreditation body, affiliates, licensee's, resellers, etc).

The learning content is broken down into 12 modules (learning objects) with a total of 115 lessons (learning unit). A lesson is presented as a slide with suitable visual hooks to assist comprehension. Each lesson is further complemented by a Note (Contextual Information), Reference (references to the PRINCE2® Manual), Audio Narration (Linking up Concepts), Lesson Quiz (Comprehension / Retention), Task (Application of Concepts). These are guided by Gagne's (1987) nine events of instruction discussed in the literature review. Similarly, additional support resources and exam simulations are provided at the module level.

The core learning content (modules and lessons) adopt a behavioural pedagogical style of instruction to introduce and build on concepts. The learning environment complements this with notes, references, narration, tests, tasks, forum and support materials to foster cognitive & constructivist (active and social) learning by promoting exploration, experimentation, construction, collaboration and reflection.

Although the learning content is structured for linear progression the learners are allowed the flexibility to choose their preferred approach guided by the principles of andragogy (Knowles, 1990). Subtle progress bars remind users of the extent of progress; similarly module tests advise learners of the level of understanding vis-à-vis the module and the expected levels for certification.

Although the learning package supports up to practitioner level of study, the stated Learning Objective of the underlying project was to achieve a foundation level (Blooms Knowledge & Comprehension) competence and qualification with guidance of 20 hours of study.

The Learning Content and the Syllabus is formally accredited by the Governing Body, APM (Association of Project Management) Group who in turn are UKAS (United Kingdom Accreditation Service) accredited.

3.1.1.2 Learning Path, Support & Environment

The learning program is initiated after a brief face-to-face (classroom) induction session with introductions to the subject matter, product, e-Learning and collaboration facilities. These sessions are led by an accredited trainer. On completing the learning the users/training co-ordinators arrange for the PRINCE2® qualification exams which is invigilated, closed book, timed, multiple-choice style exams (with a pass mark of 55%). Successful candidate's names are entered into the publicly accessible PRINCE2® Successful Candidates Register.

Asynchronous collaboration is facilitated through a dedicated forum on an associated portal. Most participating organisations also make provisions for specific time for the learning during working hours; however the users are free to access the learning platform from anywhere, at anytime as long as they are connected to the internet.

3.1.1.3 Learning Champion / Mentoring System

The initiative is spear-headed by a Learning Champion at each of the participating organisations. The Role of the Learning Champion is to entice buy-in from the management and encourage wider participation from across the organisation (time commitments / motivation / face to face events). The Learning Champion is further complemented by a mentoring (buddy) system whereby each learner is allocated a mentor from within the organisation. The Mentor's are typically individuals that have recently qualified in the method. The role of the Mentor is to allay fears, answer queries and provide support and encouragement during the learning process.

3.1.2 Participants

The user base is homogeneous containing mature professionals in the age group of 28 - 45 with between 2 - 5 years of project management experience. The uniqueness of the user base is in the fact that they all come from public sector organisations within the UK.

In Phase 1, 20% (N=28 of 140) of the learners had completed their learning i.e., taken their exams and qualified / certified (PRINCE2® Foundation). 42% (N=100 of 238) of the learners had completed their learning at Phase 2.

3.1.3 Phases

The project for PRINCE2® e-Learning was launched in April 2005 after a brief pilot. The research data was collected at two distinct time points (14 and 28 months) for the purpose of analysis and review. At 14 months there were 140 users spread across 11 participating organisations.

The second round of data was collected 28 months from the start of the project (14 months from the previous data point) and the observations are tabulated and discussed under Phase 2. At this point, 238 users had used the learning system from across 18 distinct local authorities in the UK. The users had collectively clocked about 2562 hours (mean 11hrs) of learning spread across 4572 logins (mean 19). Due to the nature of the method, the sample was obtained opportunistically and not at random.

3.1.4 Research Questions

The sponsoring organisation (SPOCE) initiated the research collaboration with Bournemouth University to help answer questions such as: Why do some learners do better than others? What learner differences / attributes set them apart? Can we identify good learning practices that might be incorporated into future learning initiatives / projects. Following literature review, the following objectives and research questions were developed.

The research questions are explored as hypotheses (H), alternative hypotheses (AH) and null hypotheses (N).

Research Objective:

How does Modality preference, Learning Style & Pattern of Usage affect online project management training/e-Learning Completion, Time to Completion & Time Spent?

Given the multi-media rich nature of the online training content, it may appeal more to some preferences/styles than others. For instance, individuals with Visual preferences (images, animations, flow charts) may perform better than the Kinesthetic, Read/Write & Auditory preferences. Similarly, auditory preferences (audio narration) may perform better than Kinesthetic & Read/Write.

Research Question 1: Do some users with certain modality preferences perform better than others in an adult e-Learning Environment
H: Visual & Auditory preference will perform better at completion and time to completion.
AH: Kinesthectic & Read/Write preferences will perform better at completion and time to completion despite the mis-match to their preference.
N: Learning Preference has no affect on completion and time to completion.

Research Question 2: Do some learning styles perform better than others in online project management training.
H: The Intuitives will perform better than the intermediates and analysts
AH: The Analyst will perform better.
N: Learning Style has no affect on completion and time to completion.

Research Question 3: How does Pattern of Usage impact, Time to completion and Time Spent in online project management training.

H: Frequent but short learning patterns will show better Time to completion & Time Spent (the spacing effect universal)
AH: The Spacing effect does not work in online project management training for adults.
N: Learning pattern has no impact at all on Time to Completion & Time Spent.

3.1.5 Materials

Four types of data were collected –

1. The quantitative data on learner's usage and progress was collated from the underlying Learning Management System implemented as part of the learning platform.

2. Pre-Use: The learner's objectives and motivations for enrolling were collected using a questionnaire. The questionnaire was presented the very first time the users logged into the system, prior to access to the learning modules. The questionnaire covered a section each on Objectives / Motivations for Enrolling, Key Drivers, Learning Approach, Time Budgeted & Prior Experience with e-Learning. (Appendix G)

3. During-Use: Learning preference/Modality questionnaire was presented as part of the learning process. The questionnaire uses VARK (Visual, Aural, Read / Write & Kinesthetic) Inventory developed by Fleming, N. D. (2005). (Appendix H)

Fleming and Mills (1992) suggested four categories that reflect the experiences of the students and teachers. Although there is some overlap between categories, they are defined as follows.

Visual (V): This preference includes the depiction of information in charts, graphs, flow charts, and all the symbolic arrows, circles, hierarchies and other devices that instructors use to represent what could have been presented in words. It does NOT include movies, videos or PowerPoint.

Aural / Auditory (A): This perceptual mode describes a preference for information that is "heard or spoken." Students with this modality report that they learn best from

lectures, tutorials, tapes, group discussion, email, speaking, web chat, talking things through.

Read/write (R): This preference is for information displayed as words. Not surprisingly, many academics have a strong preference for this modality. This preference emphasises text-based input and output - reading and writing in all its forms.

Kinesthetic (K): By definition, this modality refers to the "perceptual preference related to the use of experience and practice (simulated or real)." Although such an experience may invoke other modalities, the key is that the student is connected to reality, "either through concrete personal experiences, examples, practice or simulation" (Fleming & Mills, 1992).

The Cognitive Style Index (CSI) (Allinson & Hayes, 1996) was introduced after Phase 1 and is used to assess the learner's cognitive style preference on a dimension labelled as 'intuition-analysis' dimension. (Appendix I)

Cognitive style (often interchangeably used in literature as learning style, relates to the second layer of Curry's (1983) Onion Model (discussed in section 2.5) and has been described as 'Consistent individual differences in preferred ways of organising and processing information and experience' (Messick, 1984). Sadler-Smith (1999) highlights that styles describe 'different' rather than 'better' thinking processes. There are to date no consistent categorisations of cognitive style; for instance the intuition-analyst dimension (Allinson & Hayes, 1996), reflective-impulsive dimension (Kagan et al., 1964), serialist-holist dimension (Pask, 1972), convergent-divergent dimension (Guildford, 1959), field dependent - independent dimension (Witkin & Goodenough, 1977), wholist-analyst / verbaliser-imager dimension (Riding & Cheema, 1991), etc..

Amongst the large number of dimensions and inventories, the Cognitive Style Index (CSI) (Allinson & Hayes, 1996) was short listed for the study mainly encouraged by the results of a large-scale study of learning style inventories (Coffield, et al. 2004) which highlighted that it is one of the more reliable and valid learning style instruments among 71 inventories used in research conducted between 1970 to 2000. The authors also

report a test-retest reliability of the instrument at (r=0.90, p< 0.001) and internal consistency scores measured by Cronbach's alpha to range from 0.84 to 0.92. The Inventory is administered through a 38 item questionnaire that lends itself to be self administered online without any need for expert guidance.

These questionnaires were presented on subsequent logins to avoid any potential questionnaire fatigue.

4. Qualitative data on learning environment and support systems were collected through interviews, discussions and interactions with learners, mentors and learning champions during the project.

3.1.6 Procedure

This section describes and reviews the analysis method and its limitations. This is followed by the discussion of some of the key review perspectives and their basis. .

3.1.6.1 Analysis Method and Limitations

The qualitative part of the study was based on the learners in the initial pilot. The learners were selected by the participating organisations and therefore might be subject to selection bias. The quantitative part of the study on the other hand analysed the data in its entirety (all learners) rather than by statistical sampling. However, the list of learners still came in from the participating organisation and therefore might also have been subject to selection bias.

In the quantitative part of the study, each study Phase starts by describing the results of the pre-use survey questionnaire to assess the overall motivation levels amongst the learner audience. This is followed by the analysis of the descriptive statistics of the key attributes. Various review perspectives by Time Spent, Learning Progress & Modal Preference are explored individually and collectively. Statistically significant relationships (correlation coefficient) and differences are highlighted and discussed. Finally the

completed users as a discrete group are subjected to a further review to explore any significant trends and patterns.

The second Phase of the study also looked at the results of the Cognitive Style Index introduced as a result of the first phase. Some of the usage parameters are also subjected to a regression analysis and explored further using the concept of The Spacing Effect.

There have been no attempts to directly or indirectly influence/control participant behaviour. Specific guidance on using the learning system was provided during the induction session including information on the questionnaires presented and the assurance of confidentiality and anonymity.

There is however a risk of participants choosing to provide incorrect responses to questions or sharing their login details with friends which might affect the underlying data. Pearson's index of skewness did not present any outliers. Similarly, four of the learners who chose to progress to the higher practitioner level of study where excluded from the data analysis.

Any extraneous variables that could affect the intrinsic motivation or the pace/urgency of the learner were captured with a pre-learning questionnaire that had a section each on Objectives/Motivation, Key Drivers, Learning approach, Time budgeted and Prior experience. (Appendix G)

3.1.6.2 Review of Time Spent

The Time spent attribute was originally computed on the basis of the time between login and logout, however this form of measure showed some oddities as a result of the decision not to implement a session time out feature in the learning application. Subsequently all time spent measures have been computed on the basis of the time between requests for subsequent lessons.

Morning Twilight Hrs	8 -10 AM
Morning Core Office Hrs	10 – 12 AM
Lunch Break Hrs	12 – 2 PM
Noon Core Office Hrs	2 – 4 PM
Evening Twilight Hrs	4 – 7 PM
Night & Early Morning Hrs	7 PM – 8 AM
Weekend Hrs	Sat & Sun

Table 3 : Time Spent categorisation blocks

The Time Spent parameter/measure is further broken down into 7 key blocks (table 3 above) of time of day to gain a better appreciation of the usage pattern. The basis of separation has been guided by the typical working hours as reported by the users of the learning system in the interviews conducted during the pilot study.

3.1.6.3 Review by Learning Progress

The fact that each learner may have a different start point makes it a challenge to compare and contrast (identify and isolate) key observations pertaining to the learning attributes. Similarly, even if individual users shared a common start date, they would be progressing on their own individual pace and therefore at different stages of the learning process.

Therefore the users are categorised into discrete groups on the basis of their overall progression through the learning. The objective is to compare and contrast the key attributes of each of these discrete sets of users.

Five discrete groups have been identified.

No-Logins

This group of users are yet to use the system and are identified by no logins. A set of users awaiting the roll out of the initiative within their organisation.

Non-Starters

This group of users have 2 or less logins and haven't logged back in the preceding 5 months. The basis for this grouping was to isolate users in the system that did not have any intentions to complete the learning in the first place. For example, there were instances where senior management (Councillors, CEO) joined up to motivate their organisation and demonstrate/rally their support of the initiative.

Drop-Outs

This category of users has more than 2 logins but have neither completed nor had any logins in the preceding 5 months.

In-Process

This group represents active users who are yet to complete their learning.

Completed

Completion of the learning can be deducted from various parameters. The extent of progression through the learning modules is one of the measures. Scores achieved in the self assessment tests can also be a key indicator of completion. Similarly, time spent. However, one might argue that considering these parameters on their own can be misleading as, one may achieve higher progress statistics just as a result of skim reading rather than the recommended learning progression. One of the solutions is to deduce completion on the basis of a combination of the key parameters. However in this study, completion has been measured purely on the basis of the learners achieving the industry certification in the methodology.

3.1.6.4 Review by Modal Preference

An online version of the VARK Learning Preference Inventory was used. The acronym VARK stands for Visual, Aural, Read/write, and Kinesthetic sensory modalities that are used for learning information and was developed by Neil Fleming, Lincoln University, New Zealand.

The VARK questionnaire is administered through a set of 16 multiple choice questions (Appendix H). The questionnaire however is yet to be statistically validated. Although there are only four different preferences on the VARK scale, there are 23 different permutations of preferences. Each single preference can be mild, strong or very strong preference for that mode. In addition, it is possible to be multi-modal, with any combination of the preferences (eg AR, VRK or even all four VARK). Students who are multi-modal often need to process information in more than one mode in order for learning to occur.

3.1.6.5 Ethical Considerations

The participants were assured of anonymity and confidentiality. The responses to the questionnaire were recorded into the database using the learner's unique user id (primary key) rather than their names or any other personally identifiable data. The unique user ids were used consistently across the system to link and identify associated attributes across the system.

3.2 Phase 1

This section reviews the first round of data collected in the Phase 1 of the project, 14 months after the launch of the project.

At this point 140 users had registered on the system. The users come from across 11 distinct local authorities / organisations and have collectively spent about 950 hours (Mean – 6.40 hours) spread across 1747 logins (Mean - 12).

Three of the 11 groups had over 30 learners each and collectively account for about 80% of the total users in the system. One of the groups has over 10 users and the remaining 7 groups have less than 5 users each.

Summary of pre-learning Questionnaire

The learner's objectives and motivations for enrolling were assessed/collected using a pre-learning questionnaire. The questionnaire was presented the very first time the users logged into the system, prior to access to the learning modules. The questionnaire covered a section each on Objectives/motivations for enrolling (Obj), Key drivers (KD), Learning Approach (AL), Time Budgeted & Prior Experience with e-Learning (PE). (Appendix G)

The questionnaire used multiple choice pattern with an option to select more than one if applicable and an option to give their own views if none of the options were applicable.

Pre-Learning Questionnaire	N	Selected	Proportion
Obj:A1-Job Requirement	107	22	20.56%
Obj:A2-Relevant to the Job Profile	107	64	59.81%
Obj:A3-Useful to your Job	107	63	58.88%
Obj:A4-Because its available	107	11	10.28%
Obj:A5-Other	107	3	2.80%
KD:A1-Professional Upgrading	107	35	32.71%
KD:A2-Industry Certification	107	18	16.82%
KD:A3-Good Addition to Resume	107	43	40.19%
KD:A4-Contribute to Professional Progression	107	70	65.42%
KD:A5-Mandated by Training Function	107	9	8.41%
KD:A6-Other	107	4	3.74%
AL:A1-Time Budget	107	33	30.84%
AL:A2-Learning Plan	107	31	28.97%
AL:A3-Adhoc	107	49	45.79%
AL:A4-Other	107	3	2.80%
PE:A1-Lead to Formal Qualification	107	5	4.67%
PE:A2-Informal Learning	107	21	19.63%
PE:A3-Never	107	79	73.83%
PE:A4-Other	107	1	0.93%
Valid N (listwise)	107		

Table 4: Phase 1 - Results from the Pre-Learning Questionnaire

The responses to the pre-questionnaire (table 4) were available from 76% (107) of the users. Nearly 60% of the users quoted relevant/useful to the job as their key objective for the learning, 13% seem to not show particularly strong motivations and could be interesting candidates to observe for potential discontinuation/drop out later in the study. Professional progression is quoted (65%) as one the key driver for taking the learning, clearly a motivated audience. Most users claim to use a combination of time budget, learning plan and an adhoc approach to learning. Three quarters of the users do not have any prior experience with e-learning.

Pattern of Total Time spent

(Time Spent HH:MM:SS)	N	Maximum	Sum	Mean	Std. Deviation	Proportion
Morn Twilight TS 08:10AM	140	6:13:20	60:37:59	0:25:59	0:58:29	6.30%
Morn Core Office TS10:12AM	140	13:39:53	201:08:58	1:26:12	2:28:51	20.89%
Lunch Break TS 12:14PM	140	16:10:58	175:44:46	1:15:19	2:29:25	18.25%
Noon Core Office TS 14:16PM	140	18:23:02	248:34:14	1:46:32	3:08:40	25.81%
Even Twilight TS 16:19PM	140	12:40:19	128:51:51	0:55:14	1:57:12	13.38%
Night TS 19:08AM	140	8:25:21	60:56:44	0:26:07	1:18:38	6.33%
Weekend TS	140	24:18:50	87:01:58	0:37:18	2:44:22	9.04%
Total Time Spent	140	53:30:16	962:56:30	6:52:41	10:48:05	100.00%
Avg Study Time	140	3:12:56	61:13:30	0:26:14	0:30:45	
AvgTimeBetweenLogins(Days)	140	76	881	6	12	
Valid N (listwise)	140					

Table 5: Phase 1 - Pattern of Total Time Spent

The table 5 above summaries the Time Spent parameter expressed in hours:minutes:seconds format. This is broken down into 7 key blocks (identified in table 3) of time of day to gain a better appreciation of the usage pattern. The majority of the usage is during core office hours (46%), about 65% between 10AM and 4PM. nearly a fifth each during lunch breaks and twilight (morning and evening) and 9% during weekends.

3.2.1 Review by Learning Modal Preference

Although there are only four different preferences on the VARK scale, there are 23 different permutations of preferences. Each single preference can be mild, strong or very strong preference for that mode. In addition, it is possible to be multi-modal, with any combination of the preferences (eg AR, VRK or even all four VARK) (Appendix A). Students who are multi-modal often need to process information in more than one mode in order for learning to occur.

Modal Preference	Nos	Percentage	VARK Online Database
V	2	2.06%	2.70%
A	2	2.06%	7.70%
R	13	13.40%	13.30%
K	13	13.40%	13.20%
Bi-Modal	13	13.40%	15.20%
Tri-Modal	21	21.65%	12.50%
Multi-Modal	33	34.02%	35.40%
NA	43		
Total	140		76252

Table 6: Phase 1 - VARK results

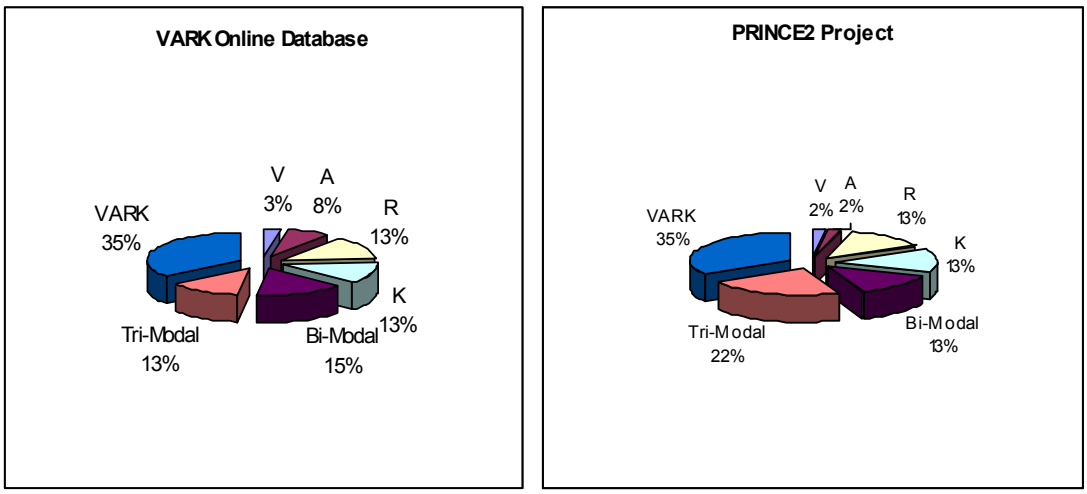

Table 7: Phase 1 - Comparison of results between PRINCE2 project and the VARK online database

The table 6 and the pie chart above (table 7) represents the results from the VARK Online Database, n=76252 (Sep 2010), comparing this with the results from the PRINCE2 project, n=140, valid response n=97 (Phase I).

- 31% of the learners were single preference.as opposed to 37% in the online database.
- A (Aural) as a single preference is lower than in the online database.
- The proportion of Tri-modal preference is higher than in the online database.
- The online database constitutes a majority of students and a small proportion of teachers; the participants of our project are all adult management professionals employed in the public sector.

Learn Pref	N	Usage Freq	Time Spent	Days	NL	NS	DO	IP	CP	Overall Progress	Overall Score	P2 Score
	Nos	Avg	AvgHrs	Avg	%	%	%	%	%	Avg	Avg	Avg
V	52	20.4	10.8	114.6	0%	0%	10%	58%	33%	45.8	49.1	26.6
A	45	16.6	10.5	90.2	0%	4%	11%	62%	22%	40.4	48.8	25.2
R	71	16.8	9.6	98.2	0%	3%	13%	58%	27%	37.3	45.0	22.5
K	73	18.8	10.5	102.9	0%	1%	11%	63%	25%	40.5	45.7	22.0

Table 8: Phase 1 – VARK results with Learning Progress

Learn Pref	N	Non Office Hr Logins	Non Office Hr Logouts	Weekend Time Spent	Morn Twilight 8 – 10 AM	Morn Core Office 10 - 12 AM	Lunch Break 12 – 14 PM	Noon Core Office 14 – 16 PM	Even Twilight 16 – 19 PM	Night 19 – 08 AM	Avg Study Time	Avg Time Between Logins
	%	Avg	Avg	%	%	%	%	%	%	%	Mins	Avg
V	22%	3.8	3.7	13%	6%	20%	18%	24%	13%	6%	38	8.5
A	19%	3.7	3.6	16%	6%	18%	16%	22%	13%	8%	41	8.5
R	29%	2.9	2.9	11%	6%	20%	17%	26%	15%	5%	35	9.3
K	30%	3.2	3.0	10%	6%	20%	19%	26%	14%	5%	36	8.6

Table 9: Phase 1 – VARK results with Time Spent Blocks

Learn Pref	ObjA 1	ObjA 2	ObjA 3	ObjA 4	ObjA 5	KDA 1	KDA 2	KDA 3	KDA 4	KDA 5	KDA 6	TBWks	TBHrs	ALA 1	ALA 2	ALA 3	ALA 4	PEA 1	PEA 2	PEA 3	PEA 4
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
V	13%	56%	60%	13%	6%	35%	23%	40%	67%	8%	2%	0%	0%	29%	33%	44%	6%	10%	21%	67%	2%
A	11%	56%	62%	16%	7%	33%	22%	42%	76%	7%	2%	0%	0%	29%	29%	47%	7%	7%	24%	67%	2%
R	17%	61%	62%	11%	4%	31%	23%	44%	70%	6%	4%	0%	0%	32%	31%	42%	4%	6%	24%	68%	1%
K	21%	59%	58%	12%	4%	38%	21%	37%	64%	11%	4%	0%	0%	30%	32%	42%	4%	5%	18%	74%	1%

Table 10: Phase 1 – VARK results with Pre-Learning Questionnaire data

The table 8 above summarises the learning progress with respect to their modal preference. Similarly, table 9 looks at the time spent pattern categorised by the modal preference. Finally, table 10 summarises the responses to the pre-learning questionnaire categorised by their modal preference.

Although Visual modal preference is one of the smaller categories (22%), the individuals with Visual modality have a higher proportion of completions and lower proportion of drop outs. This is further illustrated by the higher scores and progress levels. The Average time spent is surprisingly not very much higher from the other modalities however the usage frequency is higher indicating frequent but smaller study periods.

The Aural modality is the smallest of the categories (19%) and also has a higher proportion of Dropouts & Non- Starters (15%) and lowest proportion of completions despite relatively higher progress and scores. The usage frequency and time spent parameters suggest less frequent logins and longer study periods (Average 41Mins). The Individuals with this modality preference also tend to do more of their learning during weekends (16%) and late evenings (8%).This category also has a slightly higher proportion of individuals quoting 'Because its available' as their objective for taking up the learning.

The Read/Write modal preference is one of the bigger categories (29%) and has a relatively higher proportion of Dropouts & Non-Starters (16%) as well as a higher completion rate. The usage pattern (shorter study durations) combined with lower progress level raises the question if the learners might be spending relatively more time reading the physical manual.

The Kinesthetic modal preference is the biggest of the categories (30%) and has a relatively higher proportion of completions and lower dropouts. The usage pattern suggests frequent but shorter study periods.

As is evident from the responses on the pre-questionnaire (objectives, key drivers, learning approach, Table 10), there are no significant differences in motivation levels between individuals across modal preferences. Therefore it may be argued that all

learners are more or less equally motivated to pursue the learning irrespective of their modal preference.

3.2.2 Review by Learning Progress

In this section the users are categorised into groups on the basis of their overall progression through the learning. The objective is to compare and contrast the key attributes of each of these discrete sets of users.

Learning Progress

		Frequency	Percent	Cumulative Percent
Valid	**No-Logins**	30	21.4	21.4
	Non-Starters	9	6.4	27.9
	Drop-Outs	12	8.6	36.4
	In-Process	61	43.6	80.0
	Completed	28	20.0	100.0
	Total	140	100.0	

Table 11: Phase 1 – Learning Progress Categorisation

Five discrete groups have been identified.

No-Logins

Unusually large number of users in this group, this is on account of a new organisation joining the initiative but awaiting a formal launch to roll it out to its users.

Non-Starters

This group of users have 2 or less logins and haven't logged back in the preceding 5 months. The average usage is 1.4 logins with an average time spent of 26 minutes spread over an average of 5 days. Detailed descriptive statistics are tabulated under Appendix C.

Drop-Outs

This category of users has more than 2 logins but had neither completed nor had any logins in the preceding 5 months. This group had an average of nearly 11 logins spread over 35 days with nearly 6 hours of study (system wide average 6.8Hours).

In-Process

This is the largest of the groups (43%) and represents active users who are yet to complete their learning. This group also had about 11 average logins spread over 66 days with average 6.24 hours of study. The figures are not too dissimilar to the Drop-Out category above.

Completed

This category forms about 20% of the total users. The average usage is about 32 logins spread over 7 months and about 18 hours of study. Detailed descriptive statistics are tabulated under Appendix D.

User Status	N	Usage Freq	Time Spent	Days	V	A	R	K	Overall Progress	Overall Score	P2 Score
	Nos	Avg	AvgHrs	Avg	%	%	%	%	Avg	Avg	Avg
No-Login	30	0.0	0.0	0.0	0%	0%	0%	0%	0.0	0.0	0.0
Non-Starters	9	1.4	0.4	5.7	0%	40%	40%	20%	3.6	17.6	0.0
Drop-Out	12	10.8	5.8	35.6	19%	19%	32%	30%	31.9	29.6	11.3
In-Process	61	11.4	6.2	66.3	21%	19%	28%	32%	22.5	31.8	8.8
Completed	28	32.5	17.7	213.8	27%	15%	30%	28%	79.8	75.4	57.1

Table 12: Phase 1 – Learning Progress with VARK results

	N	Non Office Hr Logins	Non Office Hr Logouts	Weekend Time Spent	Morn Twilight 08 – 10 AM	Morn Core Office 10 – 12 AM	Lunch Break 12 – 14 PM	Noon Core Office 14 – 16 PM	Even Twilight 16 – 19 PM	Night 19 – 08 AM	Avg Study Time	Avg Time Between Logins
	%	Avg	Avg	%	%	%	%	%	%	%	AvgMins	AvgDays
No-Login	21%	0.0	0.0	0%	0%	0%	0%	0%	0%	0%	0.0	0.0
Non-Starters	6%	0.1	0.1	0%	1%	24%	27%	41%	0%	7%	21.30	1.5
Drop-Out	9%	0.5	0.4	0%	8%	28%	21%	30%	12%	0%	43.59	9.0
In-Process	44%	2.4	2.2	5%	7%	21%	20%	26%	14%	6%	29.05	7.1
Completed	20%	6.5	6.6	14%	6%	19%	16%	25%	13%	7%	42.04	11.7

Table 13: Phase 1 – Learning Progress with Time Spent Blocks

User Status	Obj A1	Obj A2	Obj A3	Obj A4	Obj A5	KD A1	KD A2	KD A3	KD A4	KD A5	KD A6	TB Wk	TB Hr	AL A1	AL A2	AL A3	AL A4	PE A1	PE A2	PE A3	PE A4
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
No-Login	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Non-Starters	22%	56%	56%	0%	0%	33%	0%	33%	67%	11%	0%	0%	0%	22%	11%	56%	0%	0%	33%	56%	0%
Drop-Out	0%	83%	42%	8%	0%	25%	17%	42%	58%	0%	0%	0%	0%	33%	33%	33%	0%	8%	25%	67%	0%
In-Process	25%	49%	56%	10%	3%	30%	13%	34%	56%	13%	7%	0%	0%	31%	31%	41%	5%	3%	15%	75%	2%
Completed	18%	68%	68%	14%	4%	39%	29%	50%	82%	0%	0%	0%	0%	29%	25%	54%	0%	7%	21%	71%	0%

Table 14: Phase 1 – Learning Progress with Pre-Learning Questionnaire data

The table 12 above summarises the modal preference by learning progress. Table 13 looks at the time spent pattern with respect to the learning progress. Table 14 summarises the responses to the pre-learning questionnaire categorised by their learning progress.

There are no Non-Starters with the Visual modal preference. The remaining learner progress groups (Drop-Out, In-Process & Completed) reflect the general spread (skewed towards R & K, Table 12) of individuals across the modal preferences. There are a higher proportion of Read/Write (R) modal preference among the Drop-Outs (and also among the completed users), although there are slightly more individuals with Kinesthetic modal preference than R.

One of the key attributes of the Drop-Outs as a group is that the learning happens only during working hours and none during the late evenings / early morning or weekends (Table 13). The completed learners as a group do a fifth of their learning outside working hours (14% of their learning during weekends and about 7% during late evenings / early mornings). The Drop-Outs also had a lower frequency of usage but strangely a much higher average study period (44 Minutes) and a longer time between logins.

As is perhaps to be expected the Drop-Outs do not claim 'Job Requirement' (Obj:A1) as one of the objectives, majority of the learners quote 'Relevant and useful to the job' (Obj:A2) as the key objectives for pursuing it (Table 14). The higher proportion of learners quoting the first 3 objectives indicates generally higher levels of motivation to start with, however these motivation levels may not be sustained unto completion as is evident from the drop-outs (Relevant & Useful – Obj:A2 & Obj:A3 but not a Requirement of the job Obj:A1).

The responses to the key drivers indicate intrinsic motivation and generally a positive set of people across the groups. The higher proportions of completed users claim 'industry certification' (KD:A2) as one of the key drivers as opposed to the rest of the groups. Majority of the users are new to e-Learning, a fifth had used it for informal learning and a small number had used e-Learning for some form of formal qualifications.

3.2.3 Exploring Differences

A third of the drop-outs are of 'R' (Read/Write) modal preference (Table 12). This is higher than any other type of modal preference in the group, similarly the completed learners also had a higher (30%) concentration of 'R' (Read/Write) modal preference higher than any other type of modal preference in the group.

The drop-outs have committed on an average about 6 Hours on the learning across an average of 11 logins spread across a duration of 35 days. The majority (80%) of this time spent is during core office hours the remaining 20% is spread across morning and evening twilight hours, none during late evenings and weekends. The completed learners had done about 20% of their learning during late evenings and weekends (11% by in-process learners) (Table 13).

Strangely, *[not anymore in light of the Spacing Effect]* the drop-outs had higher average study duration (44 Minutes) than in-process learners (29 Minutes) and slightly higher than even completed learners (42 Minutes). The drop-outs made higher overall progress (32%) than in-process learners (22%) however the overall scores were lower at 30% as opposed to 32%.

The attributes Usage Frequency, Time Spent, Days, Overall Progress, Overall Score, PRINCE2® test, Non Office Hr Time Spent, Morning Core, Noon Core & Average Study Time showed statistically significant differences (Appendix B - One Way Annova analysis $p < 0.001$) between the learner progress groups (No-Logins, Non-Starters, Drop-Outs, In-Process, Completed). Taking a closer look using Scheffe Post Hoc Tests (Appendix C) to examine specific differences within the group; the completed user group as is expected shows differences (higher values) with all other groups on Usage Frequency, Time Spent, Duration of Study, Overall Progress, Overall Score & PRINCE2® Score. Similarly the Non Office Hr Logins, Logouts & Non Core Hrs show a similar trend although at a lower significance level ($p< 0.01$). The time spent by completed learners during Morning Core Office Hrs(10-12AM), Noon Core Office Hrs(14-16PM), Evening Twilight Hrs (16-19Hrs) show differences with all our learning progress

groups excepting the Drop-Out group. This trend however does not occur in Morning Twilight Hrs(8-10AM) & Lunch Break Hrs(12-14PM).

Although there isn't any statistically significant difference (Appendix B) in Average Study Time or Average Time Between Logins, strangely the Drop-Out group had higher Average Study Time than any other group as seen in the table below. Similarly the Average Time Between Logins for the Drop-Out Group is higher than all groups except completed users.

AverageStudyTime **Scheffe**

		Subset for alpha = .05	
UserStatus	N	1	2
No-Logins	30	.000	
Non-Starter	9	1290.056	1290.056
In-Process	61		1745.230
Completed	28		2524.120
Drop-Out	12		2638.738
Sig.		.236	.196

Means for groups in homogeneous subsets are displayed. a) Uses Harmonic Mean Sample Size = 17.864. b) The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

AverageTimeBetweenLogins **Scheffe**

		Subset for alpha = .05
UserStatus	N	1
No-Logins	30	.0000
Non-Starter	9	1.4911
In-Process	61	7.0885
Drop-Out	12	9.0000
Completed	28	11.6875
Sig.		.056

Means for groups in homogeneous subsets are displayed. a) Uses Harmonic Mean Sample Size = 17.864. b) The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Table 15: Phase 1 - Average Study Time & Average Time between logins by Learning Progress

3.2.4 Review of Completed Learners

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
UsageFrequency	28	5	97	910	32.50	19.684
TimeSpent(HH.MM)	28	1	51	496	17.72	13.001
Days	28	46.18	390.05	5985.28	213.7600	100.34096
Overall Progress	28	23.08	86.54	2235.18	79.8279	15.89195
SPRINCE_Test	28	0	99	1600	57.14	32.016
SOverall_Score	28	0	98	2110	75.35	19.545
WeekendTSHH.MM	28	0	24	66	2.36	5.420
NonOfficeHrTSHH.MM	28	0	32	120	4.27	8.095
NonOfficeHrLogins	28	0	32	183	6.54	7.063
NonOfficeHrLogouts	28	0	32	185	6.61	7.238
TimeSpent	28	1:08:12	50:50:40	491:50:21	17:33:56	12:05:21
WeekendTS	28	0:00:00	24:18:50	68:10:24	2:26:05	5:28:36
MornTwilightTS08:10AM	28	0:00:00	4:16:28	27:12:49	0:58:19	1:02:12
MornCore OfficeTS10:12AM	28	0:00:00	10:47:53	95:44:57	3:25:11	2:57:25
LunchBreakTS12:14PM	28	0:00:00	13:15:07	78:23:26	2:47:59	2:55:36
NoonCoreOfficeTS14:16 PM	28	0:07:56	18:23:02	120:48:35	4:18:53	4:12:45
EvenTwilightTS16:19PM	28	0:00:00	8:43:59	66:09:02	2:21:45	2:23:44
NightTS19:08AM	28	0:00:00	7:45:07	35:21:08	1:15:45	2:01:24
AvgStudyTime	28	0:03:10	2:41:49	19:37:55	0:42:04	0:34:59
AvgTimeBetweenLogins	28	1.36	75.92	327.25	11.6875	13.83970
Valid N (listwise)	28					

Table 16: Completed learners – Descriptive Statistics

A fifth of the users (28) had already completed the learning and had taken the certification exams to be successfully PRINCE2® qualified.

They had registered nearly 500 hrs of learning between them, averaging about 18 hrs per user, spread across an average duration of 213 days (7 months). The learners achieve an overall progress[1] of 80% and an average score of 75% before taking their exams.

45% of the usage was observed to be during Core office (10-12AM) hours. 35% during Twilight Hrs (4-7PM) and Lunch Break (12-2PM). 20% during Late Night, Early Morning

(7PM-8AM) & Weekend (Sat & Sun) (14%). The Average study time was about 33 Minutes and the average time between logins is 11 days (Range 1.3 days up to 75 days).

1] Note on Overall Progress : The Learning module contains optional module tasks recommended for practitioner level learning, therefore the maximum progress level of 87%.

Completed Learners – Pre Questionnaire	N	Selected	Proportion
Obj:A1-Job Requirement	28	5	17.86%
Obj:A2-Relevant to the Job Profile	28	19	67.86%
Obj:A3-Useful to your Job	28	19	67.86%
Obj:A4-Because its available	28	4	14.29%
Obj:A5-Other	28	1	3.57%
KD:A1-Professional Upgrading	28	11	39.29%
KD:A2-Industry Certification	28	8	28.57%
KD:A3-Good Addition to Resume	28	14	50.00%
KD:A4-Contribute to Professional Progression	28	23	82.14%
KD:A5-Mandated by Training Function	28	0	0.00%
KD:A6-Other	28	0	0.00%
AL:A1-Time Budget	28	8	28.57%
AL:A2-Learning Plan	28	7	25.00%
AL:A3-Adhoc	28	15	53.57%
AL:A4-Other	28	0	0.00%
PE:A1-Lead to Formal Qualification	28	2	7.14%
PE:A2-Informal Learning	28	6	21.43%
PE:A3-Never	28	20	71.43%
PE:A4-Other	28	0	0
Valid N (listwise)	28		

Table 17: Completed learners – Responses to Pre-Learning Questionnaire

The responses by the completed learners to the pre-learning questionnaire in Table 17 suggests that, although the learning is not necessarily perceived as a requirement of the job (Obj:A1) they are clearly driven by its potential contribution to professional progression (KD:A4).

3.2.4.3 Exploring Relationships

Total Time Spent & Lunch Breaks / Non Core Hrs

The Total Time Spent on the learning is influenced by various factors. Some factors have more influence than others.

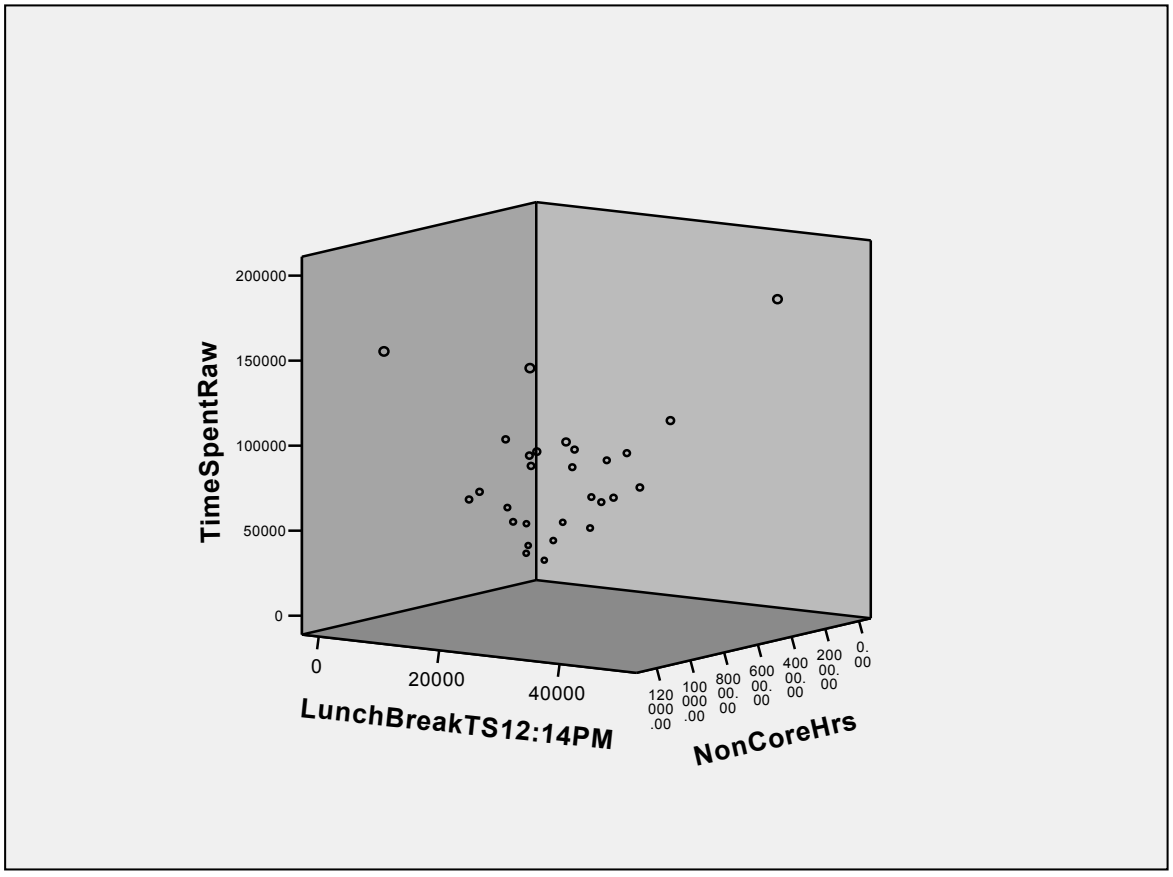

Table 18: Completed learners – Total Time Spent, Lunch Break & Non Core Hours.

Correlations

		TimeSpentRaw	LunchBreakTS 12:14PM	NonCoreHrs
TimeSpentRaw	Pearson Correlation	1	.743(**)	.893(**)
	Sig. (2-tailed)		.000	.000
	N	28	28	28
LunchBreakTS12:14PM	Pearson Correlation	.743(**)	1	.485(**)
	Sig. (2-tailed)	.000		.009
	N	28	28	28
NonCoreHrs	Pearson Correlation	.893(**)	.485(**)	1
	Sig. (2-tailed)	.000	.009	
	N	28	28	28

** Correlation is significant at the 0.01 level (2-tailed).

Table 19: Completed learners – Correlations between Total Time Spent, Lunch Break & Non Core Hours.

Learning during Lunch Breaks (12-14PM) although accounts only for 16% of the total time, it has positive high# correlation (0.74) with Total Time Spent. The coefficient of determination (r^2) is 49% i.e, 49% of the variance in Total Time Spent can be attributed to the Lunch Break.

Similarly, Non Core Hrs (excluding Core Hrs) account for about 55% of the Total Time Spent, however the correlation measure indicates a positive high# correlation (0.89). The coefficient of determination (r^2) is 64% i.e, 64% of the variance in Total Time Spent can be attributed to the Non Core Hrs.

 # Cohen & Holliday (1982) suggest 0.19 and below as very low; 0.20 -0.39 as low; 0.40 – 0.69 as modest; 0.70 -0.89 as high and 0.90 to 1 as very high.

Duration of Study & Proportion of Weekend Hrs

Correlations

		Days	PropWeekendTS
Days	Pearson Correlation	1	-.438(*)
	Sig. (2-tailed)		.020
	N	28	28
PropWeekendTS	Pearson Correlation	-.438(*)	1
	Sig. (2-tailed)	.020	
	N	28	28

* Correlation is significant at the 0.05 level (2-tailed).

Table 20: Completed learners – Correlations between Duration of Study & Weekend Hours.

A modest correlation is observed between the duration of the learning and the proportion of the learning during weekends. The direction of the correlation is negative indicating an inverse relationship. The coefficient of determination (r^2) is 16%, suggesting that 16% of the variance can be attributed to the proportion of time spent in the weekends.

Motivation, Previous experience with e-Learning & Time Spent

A clear trend is emerging in the correlations (Appendix D) between motivation and personal time spent on the learning. Learners motivated by the benefits of the learning program to their profession and career show a consistent correlation with the time spent in the weekends. This is also apparent from the qualitative comments under Obj:A5 (Enhances Career Opportunities, Requirement of the Client).

Obj:A3-Useful to your Job (67%) correlates to Usage Frequency (-.445); Obj:A4-Because its available (14%) correlates to Average. Time Between Logins (.412); Obj:A5 –Other (Enhances Career Opportunities, Requirement of the Client) (4%) correlates to Time Spent (.422) Weekend (.783); KD:A1-Professional Upgrading (39%) correlates to Weekend TS (.443); KD:A2-Industry Certification (28%) correlates to Weekend TS (.403); KD:A3-Good Addition to Resume (50%) correlates to Weekend TS (.421)

Learners with time budgets also tend to spend more time on weekends. AL:A1-Time Budget (28%) correlates to Weekend TS (.404) Similarly, previous experience with CBT/WBT (Computer Based Training / Web Based Training) has a distinct impact on how learners approach e-learning. PE:A1-Lead to Formal Qualification (7%) correlates to Time Spent (.571) correlates to Weekend TS (.815) correlates to Average. Study Time (.486); PE:A2-Informal Learning (21%) correlates to Average. Time Between Logins (.408); PE:A3-Never (71%) correlates to Weekend TS (-473)

Learners familiar with e-learning towards a qualification seem to spend significantly more time and longer study periods as is evident from the correlations. This trend is further re-emphasised by the negative correlation between weekend hrs and learners without any prior e-Learning experience. Learners with some amount of prior informal e-Learning tend to login less frequently.

3.2.5 Discussion

Review of the modal preferences revealed some interesting trends. The learners with Visual modal preference are characterised by frequent usage but with fairly shorter study durations and have the best record of completions (and lowest drop-outs). The learners with Aural modal preference, in contrast have the worst record of completions (and the highest proportion of drop-outs and non-starters). They are characterised by less frequent logins but for relatively longer periods. Read/Write modal preference have a higher than average completions and strangely higher drop-outs as well. Learners with Kinesthetic modal preference follow a similar trend to that of Visual learner's albeit at a slightly lower level.

Similarly, the review on learning progress showed that there were no Non-starters amongst the learners with Visual modal preference. Highest proportion of drop-outs came from the Read/Write Category (so too completions). Drop-outs do virtually all their learning during working hours as opposed to completed learners who do about 20% of their learning during late evenings and weekends. Drop-outs also tend to have lower frequency of usage but with higher average study duration.

Completed learners generally achieve an overall progress of 80% and an average score of 75% before taking their exams. The analysis also revealed some surprising usage patterns. The completed learners appear to spend only about 45% of their learning time during core office hours, the remainder 35% during twilight hours & lunch break and 20% during late nights and weekends.

Time spent during lunch breaks and Non core hours shows positive high co-relation with Total time spent (0.74 & 0.89, $p<0.01$) suggesting that, allowing study time during office hours leads to lower learning time, on the other hand, studying during one's own time will require higher time (more hours) to complete the learning. Proportion of weekend Hours show a modest negative correlation (-0.43 at 0.05 sig level) with duration of study (start to finish), suggesting that studying during weekends can help reduce time to completion of the learning.

Similarly, learners motivated by the benefits of the learning program to their profession and career show a consistent correlation with the time spent in the weekends. This relates with the 'Readiness to Learn' principle of andragogy (Knowles, 1980). Learners familiar with e-Learning towards a qualification spend significantly more time on the learning ('Role of learners experience' – andragogic principle).

Whilst the VARK inventory provides a naturalistic, easy to understand means to identify user attributes based on modal preferences (Visual, Auditory, Read/Write & Kinesthetic). The VARK self-reported questionnaire has yet to be statistically validated (validity and reliability). Therefore it was decided at this stage to explore a statistically validated inventory which could help corroborate the observations with a longitudinal evaluation of preferences.

Similarly, some unanswered questions remained on the pattern of usage (Frequency of Usage, Study Duration and Time to Completion) particularly with respect to Drop-outs having higher average study duration and average time between study. Review of these patterns on the completed users (N=28) did not show any statistically significant differences. It was however decided to explore this further at a later stage with a larger sample.

3.3 Phase 2

This section reviews the second round of data collected in the Phase 2 of the project, 28 months after the launch of the project, 14 months after the Phase 1 of the project.

At this point 238 users had registered on the system. The users came from across 18 distinct local authorities/organisations and had collectively spent about 2562 Hours (mean 10 Hours) of learning spread across 4572 logins (mean 19). Three of the 18 groups had over 30 learners each and collectively account for about 80% of the total users in the system. One of the groups had over 10 users and the remaining groups had less than 5 users each. This Phase also looks at the results of the Cognitive Style Inventory introduced in to the learning environment at the end of the Phase 1 to address the limitations of the VARK questionnaire.

Usage Pattern (Time Spent/logins)

Time Spent HH:MM	N	Minimum	Maximum	Sum	Mean	Std. Deviation	%
Morn Twilight TS 08:10AM	238	0	8.37	197.35	0.83	1.71	7.70%
Morn Core Office TS 10:12AM	238	0	18.54	495.71	2.08	3.32	19.35%
Lunch Break TS 12:14PM	238	0	17.09	426.60	1.79	3.18	16.65%
Noon Core Office TS 14:16PM	238	0	24.49	575.49	2.42	3.94	22.46%
Even Twilight TS 16:19PM	238	0	22.57	328.66	1.38	2.75	12.83%
Night TS 19:08AM	238	0	18.71	237.60	1.00	2.46	9.27%
Weekends	238	0	51.59	300.85	1.26	4.40	11.74%
Total Time Spent	238	0	73.48	2562.26	10.77	14.32	100%
Non Office Hr Logins	238	0	45	1136	4.77	8.02	24.85%
Non Office Hr Logouts	238	0	45	1081	4.54	7.99	23.64%
Total Logins	238	0	126	4572	19.21	20.22	100%

Table 21: Phase 2 – Descriptive Statistics

Although participating organisations make provisions for specific time for the learning during working hours; the application is web based and the users are free to access the learning platform from anywhere, at anytime as long as they are connected to the internet. This had clearly facilitated the learning process as is evident from the descriptive statistics (table 21) of the usage pattern. Over 24% of the total logins/logouts are outside office hours (including weekends) and over a fifth of the total time spent is outside office hours (weekends 12%, Night 19 - 08AM 9%). The core office hours only account for about 41% of the total time spent on learning. This is consistent with our previous observations of 45% in Phase 1.

Pre-Learning Questionnaire

As in Phase 1, the learner's objectives and motivations for enrolling were also collected in Phase 2 using a questionnaire. The questionnaire was presented the very first time the users logged into the system, prior to access to the learning modules. The questionnaire covered a section each on Objectives/motivations (Obj) for enrolling, Key Drivers (KD), Learning Approach (LA), Time Budgeted (TB) & Prior Experience (PE) with e-Learning. (Appendix G)

The questionnaire used multiple choice pattern with an option to select more than one if applicable and an option to give their own views if none of the options were applicable.

Pre-Learning Questionnaire	N	Selected	Proportion
Obj:A1-Job Requirement	213	50	23.47%
Obj:A2-Relevant to the Job Profile	213	122	57.28%
Obj:A3-Useful to your Job	213	131	61.50%
Obj:A4-Because its available	213	20	9.39%
Obj:A5-Other	213	5	2.35%
KD:A1-Professional Upgrading	213	74	34.74%
KD:A2-Industry Certification	213	52	24.41%
KD:A3-Good Addition to Resume	213	88	41.31%
KD:A4-Contribute to Professional Progression	213	150	70.42%
KD:A5-Mandated by Training Function	213	13	6.10%
KD:A6-Other	213	5	2.35%
AL:A1-Time Budget	213	70	32.86%
AL:A2-Learning Plan	213	66	30.99%
AL:A3-Adhoc	213	98	46.01%
AL:A4-Other	213	3	1.41%
PE:A1-Lead to Formal Qualification	213	15	7.04%
PE:A2-Informal Learning	213	51	23.94%
PE:A3-Never	213	144	67.61%
PE:A4-Other	213	2	0.94%
TB:Wks	213	3297	14.48
TB:Hrs	213	825.5	3.88

Table 22: Phase 2 - Results from the Pre-Learning Questionnaire

The responses to the pre-learning questionnaire (table 22) were available from 89% (n=213) of the users. 60% of the users quoted relevant/useful to the job (Obj:A2 & Obj:A3) as their key objective for the learning; nearly 10% do not show particularly strong motivations and could be interesting candidates to observe for potential discontinuation/drop out later in the study (Phase 1 - 60% & 13%). Professional progression (KD:A4 - 70%) is quoted as one of the key driver for taking the learning. Most users claim to use a combination of time budget, learning plan and an adhoc approach to learning. Two thirds of the users do not have any prior experience with e-Learning. Overall an intrinsically well motivated set of users whilst starting the learning process. These observations are largely consistent with that of Phase 1.

3.3.1 Review by Cognitive Style

Allinson & Hayes (1996) propose a single overall dimension that covers the various facets of cognitive styles identified by previous researchers. The CSI is used to assess this single super ordinate dimension labelled as 'intuition-analysis' dimension.

> *Intuition... refers to immediate judgement based on feeling and the adoption of a global perspective. Analysis... refers to judgement based on mental reasoning and a focus on detail (Allinson & Hayes, 1996, p.122)*

The Questionnaire items are scored by means of a trichotomous response scale (true; uncertain; false;). 21 questions are analysis oriented and the remaining 17 are intuition oriented and therefore scored in a reverse fashion. Scores may vary from a minimum of 0 to a maximum of 76, the higher the score the more analytical and less intuitive an individuals cognitive style and vice versa.

Valid N	Minimum	Maximum	Mean	Median	Mode	Range	Std Dev	Percentile 33	Percentile 66
84	14	67	41.25	41.00	38	53	12.716	38.00	46.10

	Males			Females		
	N	Mean	SD	N	Mean	SD
CSI	46	39.50	12.928	38	43.37	12.290

Table 23: Phase 2 – Cognitive Style Index Descriptive Statistics

The sample as shown in table 23 above consisted of 84 respondents (average age 39.92) with a mean score of 41.25. Females constitute for 45% of the sample with a mean score of 43.37 marginally higher than the male mean of 39.50. The CSI scores by gender are consistent with the results of previous studies (Hodgkinson & Sadler-Smith, 2003; Sadler-Smith, 1999; Allinson & Hayes, 1996, 2000) which contradict the gendered stereotypic thinking suggesting that intuition is a feminine characteristic and analysis a masculine characteristic.

The sample has been categorised into three cognitive style groupings to enable further analysis, and review the relationships with other attributes of the users. Intuitives (0 < CSI < 38); Intermediates (38 < CSI < 46.10); Analyst (46.10 < CSI < 76) using the 33 & 66 percentiles as a basis for separation. (Sadler-Smith, 1999; Armstrong, 2000)

CSI	N	Male	Female	Age	Usage Freq	Time Spent	Overa Prog	P2 Test	Overa Score	V	A	R	K	UI	NS	DO	IP	CP
	N	%	%	Avg	Avg	Avg	Avg	Avg	Avg	%	%	%	%	%	%	%	%	%
Intuitives	26	69.23 %	30.77 %	42.31	20.96	15.12	50.19	35.03	54.25	73.08%	73.08%	80.77 %	84.62 %	0.00%	0.00%	0.00%	46.15 %	53.85%
Intermediate	30	50.00 %	50.00 %	37.63	19.20	11.71	42.39	30.40	49.39	53.33%	43.33%	70.00 %	66.67 %	0.00%	0.00%	0.00%	63.33 %	36.67%
Analyst	28	46.43 %	53.57 %	40.14	16.61	10.04	36.28	18.67	42.17	50.00%	46.43%	60.71 %	57.14 %	0.00%	0.00%	0.00%	67.86 %	32.14%

Table 24: Phase 2 – CSI results with VARK & Learning Progress

CSI	N	Login	Logout	Weekend	Morn Twilight	Morn Core	Lunch Break	Noon Core	Even Twilight	Night	AvgStudyTime	AvgTimeBetLogins	Days	T2C
	%	Avg	Avg	%	%	%	%	%	%	%	Mins	Days	Avg	Days
Intuitives	30.95 %	5.35	4.73	7.73%	10.14%	20.23%	17.44%	23.77%	11.74%	8.96%	43.18	31.89	254.92	248.96
Intermediate	35.71 %	5.43	5.37	15.18%	5.55%	20.76%	18.39%	19.73%	13.56%	6.83%	36.36	17.39	137.60	225.40
Analyst	33.33 %	4.64	4.39	21.92%	7.55%	15.70%	11.56%	21.19%	10.38%	11.70 %	36.16	11.17	142.87	237.61

Table 25: Phase 2 – CSI results with Time Spent Blocks

CSI	ObjA 1	ObjA 2	ObjA 3	ObjA 4	ObjA 5	KDA1	KDA2	KDA3	KDA4	KDA 5	KDA 6	ALA1	ALA2	ALA3	ALA 4	PEA 1	PEA2	PEA3	PEA 4
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Intuitives	23.08 %	46.15 %	65.38 %	23.08 %	3.85 %	38.46 %	26.92 %	46.15 %	73.08 %	3.85 %	7.69 %	34.62 %	38.46 %	46.15 %	0.00 %	7.69 %	26.92 %	65.38 %	0.00 %
Intermediate	23.33 %	63.33 %	70.00 %	3.33 %	0.00 %	43.33 %	36.67 %	43.33 %	80.00 %	0.00 %	0.00 %	40.00 %	30.00 %	43.33 %	0.00 %	6.67 %	26.67 %	66.67 %	3.33 %
Analyst	28.57 %	57.14 %	60.71 %	3.57 %	3.57 %	28.57 %	21.43 %	32.14 %	75.00 %	7.14 %	0.00 %	25.00 %	35.71 %	50.00 %	0.00 %	7.14 %	35.71 %	60.71 %	0.00 %

Table 26: Phase 2 – CSI results with Pre-Learning Questionnaire data

The table 24 above summarises the learning progress groups and modal preferences with respect to their learning style categorisation. Similarly, table 25 looks at the time spent pattern categorised by their CSI categorisation. Finally, table 26 summarises the responses to the pre-learning questionnaire categorised by their learning style.

Although Intuitives are smaller of the groups (31%), the individuals with Intuitive cognitive style had a higher proportion of completions (54%). This is consistent with the higher averages observed on Time Spent (15Hrs), Overall Progress (50%) and Overall Score (54%). This group was also older (Mean Age 42) and had a higher proportion of male (69%) learners, supporting Allinson & Hayes (2000) assertion linking seniority with intuitiveness.

This group had a higher proportion of Multi-Modal preferences with a slant towards Kinesthetic and Read/Write modal preference. They also had a higher proportion (23%) of individuals quoting 'Because it's available' as their objective for taking up the learning (correlation 0.309**, $p<0.001$), this attribute could be argued as one of the reasons for the lower proportion (half that of intermediates and a third of Analyst) of learning (time spent) during the weekend.

The Intuitives also take the longest Time to Completion, 10% higher than Intermediates and about 5% higher than Analyst. Closer examination of the usage parameters highlights an interesting pattern of longer study periods (18%) with however relatively longer gaps (twice longer gaps than intermediate and nearly 3 times longer gaps than Analyst) in between learning sessions. (correlation Average Time Between Logins 0.256* $p<0.01$, Days 0.320** $p<0.001$)

The Intermediates form the largest of the groups (36%), they were equally divided in terms of gender and were the younger of the groups (mean age 37). This group also had the lowest proportion (3.33%) of individuals quoting 'Because it's available' as their objective for taking up the learning and none quoting 'Mandated by the Training Function' as their key drivers. Similarly, the intermediates had a higher proportion of individuals quoting (80%) 'Contribute to professional Progression' as their key driver and (70%) quoting 'Useful to your job' as their primary objective. Clearly the more motivated of the groups; reflected in part by their shortest average Time to Completions.

The Analysts do more of their learning during weekends (22%) and late nights (12%) than Intuitives and Intermediates. Although this group is on the other end of the scale, strangely they seem to appear mid way between intuitives and intermediates on average age and Time to Completion.

Nearly, half the Analysts and Intermediates tend to be multi-modal as opposed to three quarters of Intuitives .

A one way Anova highlighted statistically significant differences on Average Time between Logins (f=3.14 p<0.05 df=2, 81), Days (f=4.623 p<0.01 df=2, 81) and Obj:A4-Because its available (f=4.28 p<0.01 df=2, 81).

3.3.2 Review by Learning Progress

Progress	N	Usage Freq	TimeSpent	OverallProgress	P2Test	Overall Score	V	A	R	K	Intuitives	Intermediate	Analyst	Valid
	%	Avg	Avg	Avg	Avg	Avg	%	%	%	%	%	%	%	No
No-Logins	9.66%	0.00	0.00	0.00	0.00	0.00	0%	0%	0%	0%	0%	0%	0%	0
Non-Starters	6.30%	1.40	0.35	3.85	3.64	19.29	6%	20%	20%	20%	0%	0%	0%	0
Drop-Outs	14.29%	13.26	7.56	27.12	11.73	30.46	52%	35%	58%	70%	0%	0%	0%	0
In-Process	27.73%	11.05	5.67	24.33	7.23	33.23	56%	46%	72%	59%	24%	38%	38%	50
Completions	42.02%	33.71	19.26	75.00	55.51	71.47	49%	50%	71%	69%	41%	32%	26%	34

Table 27: Phase 2 – Learning Progress with VARK & CSI results

Progress	N	NOff Login	NOff Logout	Weekend	Morn Twilight	Morn Core	Lunch Break	Noon Core	Even Twilight	Night	AvgStudy Time	AvgTime BetLogins	Days	T2C
	No	Avg	Avg	%	%	%	%	%	%	%	Mins	Days	Avg	Days
No-Logins	23	0.00	0.00	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Non-Starters	15	0.07	0.07	27.29%	1.08%	19.91%	28.06%	8.24%	15.43%	0.00%	0.20	0.00	0.13	0.00
Drop-Outs	34	2.97	2.74	8.74%	6.28%	18.85%	20.80%	25.44%	13.38%	6.52%	0.47	15.10	138.34	0.00
In-Process	66	2.12	1.91	6.70%	7.78%	23.07%	18.55%	28.04%	12.80%	3.06%	0.38	23.09	148.49	0.00
Completions	100	8.94	8.61	13.08%	7.89%	18.69%	15.70%	21.02%	12.75%	10.87%	0.65	14.70	231.66	230.71

Table 28: Phase 2 – Learning Progress with Time Spent Blocks

Progress	Obj A1	Obj A2	Obj A3	Obj A4	Obj A5	KD A1	KD A2	KD A3	KD A4	KD A5	KD A6	AL A1	AL A2	AL A3	AL A4	PE A1	PE A2	PE A3	PE A4
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
No-Logins	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Non-Starters	33.33 %	46.67 %	46.67 %	0.00 %	0.00 %	40.00 %	26.67 %	33.33 %	53.33 %	6.67 %	0.00 %	20.00 %	20.00 %	40.00 %	0.00 %	13.33 %	20.00 %	60.00 %	0.00 %
Drop-Outs	26.47 %	58.82 %	47.06 %	14.71 %	5.88 %	38.24 %	23.53 %	26.47 %	52.94 %	11.76 %	5.88 %	26.47 %	29.41 %	41.18 %	5.88 %	5.88 %	23.53 %	61.76 %	0.00 %
In-Process	24.24 %	59.09 %	69.70 %	7.58 %	1.52 %	36.36 %	25.76 %	42.42 %	75.76 %	6.06 %	1.52 %	42.42 %	33.33 %	42.42 %	0.00 %	4.55 %	27.27 %	66.67 %	1.52 %
Completions	20.00 %	56.00 %	62.00 %	10.00 %	2.00 %	31.00 %	23.00 %	46.00 %	74.00 %	4.00 %	2.00 %	30.00 %	31.00 %	50.00 %	1.00 %	8.00 %	22.00 %	70.00 %	1.00 %

Table 29: Phase 2 – Learning Progress with Pre-Learning Questionnaire data

The table 27 above summarises the modal preference and learning style with respect to the learning progress. Similarly, table 28 looks at the time spent pattern categorised by their learning progress. Finally, table 29 summarises the responses to the pre-learning questionnaire categorised by their learning progress.

There were a higher proportion of Kinesthetic modal preference among the Drop-Outs followed by Read/Write (R/W were marginally higher in Phase 1), This is reversed in In-Process and Completed groups (Table 27). The Completed learners as a group did nearly a quarter of their learning outside working hours (13% of their learning during weekends and about 10% during late evenings / early mornings) (Table 28).

The Drop-Out group had a higher proportion quoting 'Because it's available' and 'Mandated by Training function' than all other groups (Table 29). Majority of the users were new to e-Learning, nearly a quarter had used it for informal learning and a small number had used e-Learning for some form of formal qualifications.

3.3.3 Review of Completed Learners

In Phase 2, 42% of the users (N=100 out of 238) had completed the learning and taken the certification exams to be successfully PRINCE2® qualified. [Appendix E – Descriptive statistics on Phase 2 completed users]

They had recorded nearly 2000 hrs of learning between them, averaging about 20 hrs per user, spread across an average duration of 231 days (nearly 8 months). The averages had moved upwards compared to the Phase 1 figures of 18 hrs per user and 213 days to completion. Learners achieve an overall progress of 75% and an average score of 71% before taking the exams.

3.4 The Spacing Effect

In Phase 1, some unexplained trends were identified in patterns of usage (Frequency of Usage, Study Duration and Time to Completion) with Drop-outs as a group showing higher average study duration and average time between study. These differences when explored further on the completed users sample (N=28) failed to show any statistically significant differences.

This trend continued in Phase 2, the Drop-outs show higher averages compared to some of the groups. Similarly, looking at the completed users (N=100) as a group, the Intuitives take the longest Time to Completion (10% higher than Intermediates and about 5% higher than Analyst). Closer examination of the usage parameters highlights an interesting pattern of longer study periods (18%) with however relatively longer gaps (twice longer gaps than intermediate and nearly 3 times longer gaps than Analyst) in between learning sessions. (correlation Average Time Between Logins 0.256* $p<0.01$, Days 0.320** $p<0.001$)

The Spacing Effect is a robust phenomenon that suggests that the retention / recall of learning improve when presentations are spaced as opposed to massed (Toppino et al., 2002). This section explores the interplay between Average Time between logins / Inter Session Interval (ISI), Study Duration, Frequency of Usage and its impact on Time Spent & Time to Completion using the concept of the Spacing Effect.

The outcome of this part of the study is also the subject of a publication (Pereira, Taylor & Jones, 2009) titled, Less Learning More Often: The Impact of The Spacing Effect in an adult e-Learning environment. (Published Material 2)

3.4.1 Theoretical Background

Study-Phase-Retrieval (retrieval as a learning event), Encoding-Variability (multiple routes to retrieval) and Deficient Processing (in-adequate processing) are some of the theories proposed to explain the effect.

The two-factor model (also called SAM Model) Raaijmakers (2003) combined two of the more influential theories, Encoding-variability and Study-Phase retrieval. The encoding variability component of this model suggests that contextual change, occurring between the first and second occurrence of a repeated item, is stored automatically with a repeated item's memory trace. These contextual elements provide cues to facilitate retrieval (multiple routes). This is expected to improve with spacing as the number of contextual cues increases with longer intervals. However, the study-phase retrieval component of the two-factor model dictates that the contextual changes are stored in the repeated item's memory trace only if the first occurrence of a repeated item is retrieved from long-term store at its second occurrence. As a result, the Spacing Effect will only emerge for repeated items that have undergone successful study-phase retrieval.

Verkoeijin et al. (2005) demonstrated the implementation of the two-factor model and report an inverted u-shaped relationship between interrepetition spacing and free-recall. They argue that, initially, the potentially negative effect of the second process (probability of successfully retrieving a repeated item's first presentation decreases as the interval increases) will be cancelled out by the first process (the amount of contextual change and the number of contextual elements encoded with a repeated item's memory trace upon study-phase retrieval increases with the length of the interval), giving rise to the Spacing Effect. However, at a certain spacing interval the balance must reverse and performance must decline with further inter-repetition spacing.

3.4.2 Results & Discussion

The key parameters of the completed users (N=100) were subjected to a regression analysis. The parameters included were Usage Frequency represented by successful logins, Study Period represented by duration of study and Time between Logins represented by the duration between logins. The resulting regression equation (table 30) was applied to the observed mean values of the samples predictor variables (table 31).

Model	Coefficients B	Coefficients Std Error	t	Sig
Constant	-30627.1	8140.33	-3.76	.000
Usage Frequency	1463.86	146.20	10.01	.000
Mean Study Period	25.15	1.65	15.19	.000
Mean Time Between Logins (ISI)	-547.19	152.63	-3.58	.001

Dependent Variable: Time Spent

Table 30: The Spacing Effect - Regression Equation

The following is an application of the above regression equation to the observed mean values of the samples predictor variables.

	Usage Frequency (Logins)	Study Period (Minutes)	Inter Session Interval (Days)	Forecast Total Study Time (Hrs)
1	66	20	7	25
2	33.71	39	14.69	19
3	16	60	21	20
4	8	80	28	24

Table 31: The Spacing Effect - Application of the Regression Equation

The actual mean values of the sample (Usage Frequency 33.71, Study Period 39 minutes & Inter Session Interval 14.69 days) demonstrated the lowest forecast Total Study Time (19Hrs). Doubling the usage frequency whilst halving the study period ISI showed the highest forecast Total Study Time; followed by the outcome of 50% reduction in Usage Frequency and 50% increase in Study Period and ISI.

The optimal ISI (14.69) works out to be 6% taking the mean time to completion as retention interval. This is contrary to Rohrer & Pashler (2007) and Pashler, et al (2006)'s reports of 10% - 30% of the Retention Interval as optimal ISI. Similarly, a reduction in the ISI to 7 days (3%) as reported by Bahrick, et al (1993) had a detrimental effect on the forecast total study times.

The data demonstrated a strong Spacing Effect with a u-shaped function. The overall trend is consistent with the inverted u-shaped relationship reported by Verkoeijin, et al (2005) when reviewing the two-factor model (Raaijmakers, 2003).

To summarise, the Phase 1 users (n=28) achieve an average learning progress of 80% and average score of 75% before taking their certification exams. They achieved about 18hrs of study spread across an average duration (Time to completion) of 7 months (213 days). The averages are marginally higher in Phase 2 with average study of 19 hrs and Time to Completion of nearly 8 months (230 days). The average progress and scores are slightly lower at 75% and 71% on a larger base (n=100).

The completed users in Phase 1 did most of their learning (65%) outside of core-office hours with about 20% during late nights and weekends. The proportion of weekend hours showed a negative correlation (-0.43, $p<0.05$) with duration of study, suggesting that weekend study could help reduce time to completion. Similarly in Phase 2 60% of the learning occurred outside core-office hours and also over a fifth during late nights and weekends (24% of the logins and logouts were outside office hours).

The learners showed a positive correlation between motivation and total time and weekend time consistent with the readiness to learn principle of andragogy (Knowles, 1980). Similarly, learners familiar with e-learning and with prior experience of e-Learning spent a lot more time (Pearson correlation 0.571 Time Spent, 0.815 Weekend Time spent) compared to the inexperienced (-0.473 Weekend time spent) users.

Although the Visual modal preference users in Phase 1 are one of the smaller categories (22%), this category has the highest proportion of completions (33%) and a lower rate (10%) of drop-outs. The Average study time is about 33 Minutes and the average time between logins is 11 days (Range 1.3 days up to 75 days).

CHAPTER 4 – Evaluation and Discussion

This chapter analyses the observations made in the previous chapter during the two phases of the study and relates them to the research questions and the hypothesis enumerated in chapter 3.

4.1 Research Question on Modality Preference

Research Question 1: Do some users with certain modality preferences perform better than others in an adult e-Learning environment?

H: Visual & Aural preference will perform better at completion and time to completion.

AH: Kinesthectic & Read/Write preferences will perform better at completion and time to completion despite the mis-match to their preference.

N: Learning Preference has no affect on completion and time to completion.

The results showed that the hypothesis on Visual modal preference performing better on completions (33%) than other preferences holds true despite this group being smaller of the categories. The drop-out rates (10%) are also the lowest further supporting this hypothesis. However the Aural preference showed the lowest proportion of completions (22%), contradicting the second part of the hypothesis. They also had a higher proportion of drop-outs & non-starters (15%). This group is also characterised by a higher proportion (16%) of individuals quoting 'Because it's Available' as their objective for taking the learning, which might indicate lower priority / urgency / motivation. The average time spent (Table 8) did not show any significant variations. The hypothesis therefore is only partially supported.

The Read/Write modal preference on the other hand has an average completion rate (27%) and the highest drop-out rate (13%). The Kinesthetic Modal preference is the biggest of the categories (30%) and has a below average completion rate (25%) and

a relatively lower drop-out rate (11%). Again, rendering the alternative hypothesis partially true.

Comparing the above observations with the Phase 2 completion figures, the modality preference groups barely show marginal variations in their completion rates. The Aural preference is at the top at (53%), followed by Read/Write (52%), Kinesthetic (51%) and Visual (48%). Whilst this does not change the original observations against the hypothesis the preference groups have swapped places from the highest to the lowest and vice-versa. The observations on the alternate hypothesis remain the same although at slightly lower levels.

The Visual modality shows higher completions at early stages of the learning initiative, the remaining of the preferences seems to catch up over time. Whilst this might show in favour of the null hypothesis assertion, differences however remain in the Time to Completion figures observed across the modalities. The Visuals have the shortest Time to Completion at 221 days followed by Read/Write (223), Aural (225) & Kinesthetic (237 days).

To summarise, the completion rates seem to converge over time irrespective of the modality preference, this might in part be explained by the potential demands / pressures at work, promotions, peer-pressure, etc. Terrell (1999), indicate that levels of internal causality are highly correlated with levels of intrinsic motivation. That is, learners were intrinsically motivated to the degree necessary to overcome difficulties arising from the interaction of their preferred learning styles. However the differences (although not statistically significant) are still manifested in the time taken to complete the learning. A further controlled study would help to clarify the underlying dynamics.

Therefore the answer to the first research question is that the modality preferences did not vary on completions or time spent however they did show variance in Time to Completion across modalities.

4.2 Research Question on Cognitive Styles

Research Question 2: Do some learning styles perform better than others in online project management training.

H: The Intuitives will perform better than the intermediates and analysts

AH: The Analyst will perform better.

N: Learning Style has no affect on completion and time to completion.

The CSI (Cognitive Style Index) observations contradicted the gendered stereotype, suggesting that intuition is a feminine characteristic and analysis a masculine characteristic. The female population (45%) had a mean score of 43.37 marginally higher than the male mean of 39.50, this is consistent with previous studies (Hodgkinson & Sadler-Smith 2003; Allinson & Hayes 1996, 2000; Sadler-Smith, 1999).

The Intuitives are the smallest of the group (31%) and yet have the highest proportion of completions (54%) in line with the hypothesis. This group is also characterised by relatively older (mean age 42) and a higher proportion of male (69%) learners supporting Allinson & Hayes (2000) assertion linking seniority with intuitiveness.

However, the Intuitives take the longest Time to Completion (248 days), 10% more than Intermediates and 5% more than Analyst; and longer Time Spent (15.12Hrs), 29% more than Intermediates and 50% more than Analysts. Their usage patterns are characterised by longer study periods (18%) with relatively longer time between logins (twice longer than Intermediates and 3 times longer than Analyst). They also have a relatively higher proportion (23%) quoting ‘Because it’s Available’ as their objective for taking up the learning and consequently (could be argued) a lower proportion of time spent during weekends (half that of Intermediates and a third of Analyst).

The Intermediates are the largest of the groups (36%) and are evenly balanced by gender and form the youngest (mean age 37) of the groups. This group ranks second in terms of completions (37%) and yet show the shortest Time to Completions (225 days). Their higher motivation levels are evident from 80% quoting 'Contribute to Professional progression' as key drivers and 70% quoting 'Useful to your job' as their primary objective and also the lowest proportion (3%) quoting 'Because its Available' as their objective for taking the learning.

Although the Analyst's are on the other end of the scale on the dimension as well as on completions, they are however mid-way between Intuitive's and Intermediate's on average age and Time to Completion.

The Intuitive's also show a higher proportion of multi-modal preference (three quarters as opposed to half of Analyst & Intermediates), this receptiveness to broader range of learning preferences could in part be explained by the seniority / older population and consequently a higher completion rate despite the apparent lower motivation levels.

The alternative hypothesis on self-discipline grounds therefore stands unsupported and similarly the observations do not support the Null hypothesis. Although the hypothesis in favour of the Intuitive's holds true, the original basis on which the hypothesis was made is clearly not the case. The online 24x7 access did not seem to appeal as much to this group as originally anticipated as is evident from the lowest proportion of time spent during weekends by the Intuitive's.

Therefore the answer to the second research question is, some learning styles perform better than others on completions but not necessarily the same group on both completion and Time to completion. Whilst this might provide some support to the style-instruction matching argument made by Hayes & Allinson (1996) and Sadler-Smith (1999), as we have discovered it is not the only factor related to learning success.

4.3 Research Question on the Spacing Effect

3) How does Pattern of Usage impact, Time Spent and Time to Completion in online project management training.

H: Frequent but short learning patterns will show better Time Spent and Time to completion (the Spacing Effect universal)

AH: The Spacing effect does not work in online project management training for adults.

N: Learning pattern has no impact at all on Time Spent or Time to Completion

To answer this question the usage patterns (Average Time between Logins/Inter Session Interval, Usage Frequency, Study Duration, Time Spent and Time to Completion) were explored further using a concept called the Spacing Effect in chapter 3.

The Spacing Effect is a robust phenomenon that suggests that the retention/recall of learning improves when presentations are spaced as opposed to massed (Toppino et al., 2002). Although we have not located any data of this phenomenon in adult e-Learning, Dempster (1987) describes the Spacing Effect as uncommonly reliable, remarkably robust and observed in virtually every standard experimental paradigm.

The key parameters of the completed users were subjected to a regression analysis. The resulting equation demonstrated a strong Spacing Effect with a u-shaped function consistent with the inverted u-shaped relationship reported by Verkoeijin, et al (2005) when reviewing the two-factor model (Raaijmakers, 2003).

The actual mean values of the completed users (Usage Frequency 33.71, Study Period 39 minutes & Inter Session Interval 14.69 days) presented the lowest forecast Total Study Period (19hrs). Doubling the usage frequency, whilst halving the Study Period and the Inter Session Interval, showed the worst / highest forecast Total Study Time (25hrs). Similarly, 50% increase in Study Period and ISI and 50% decrease in Usage Frequency showed forecast of 20hrs, a further reduction showed a forecast Total Study Period of 24hrs.

Contrary to the optimal ISI accounts of 10% - 30% of the Retention Interval reported by Rohrer & Pashler (2007) and Pashler, et al (2006), the results indicated an optimal ISI (14.69) of about 6% taking the mean time to completion as the Retention Interval (230 days). A reduction in the ISI to 7 days (3%) as reported by Bahrick, et al (1993) has a detrimental effect on the forecast total study times.

Smaller more frequent learning instances spread over time appear to be more effective than the traditional single hit massed learning. The theoretical accounts (Encoding Variability - Glenberg, 1979; Study-Phase Retrieval - Braun 1998; Deficient-Processing - Green 1989; Two-factor Model - Raaijmakers 2003) of the Spacing Effect attribute extra cognitive effort by varied memory traces and encoding strategies for the benefits of spaced learning.

Whilst the universal applicability of the Spacing Effect remains to be established, the observations above are certainly in favour of the hypothesis of its applicability to online project management training for adult learners.

CHAPTER 5 – Summary, Implications and Conclusions

This chapter first summarises how the results of the study answer the research questions. The contributions to the state of the art are discussed in the implications and future work section. Finally, the conclusion section highlights the lessons learned.

5.1 Summary of Research Question highlights

The data showed that modality preferences, learning styles and pattern of usage are related to Completions, Time to Completions and Total Time Spent, however not necessarily on the level and basis expected.

In the first research question, the visual modality preferences performed better than others during the early stages of the learning process. However the completion rate seemed to converge over time irrespective of the modality preferences. This might in part be explained by the demands and pressures at work (such as promotions, peer-pressure, performance reviews). This would support Terrell's (1999) research linking internal causality with higher intrinsic motivation levels (where the learners were intrinsically motivated to the degree necessary to overcome difficulties arising from the interaction of their preferred learning styles). Differences by modality preference however remained in terms of the time taken to complete the learning. The lack of data on the statistical validity of the VARK Questionnaire is however acknowledged.

Similarly, in the second research question some learning styles did perform better than others in completions but not necessarily the same group on both Completions and Time to Completions. The Intuitives lagged behind on Time to Completion despite having a higher Completion rate. Some of this might be attributed to the Spacing Effect. The Intuitives usage pattern was characterised by longer study periods (18%) with even longer gaps (two times longer than Intermediates and three times longer than Analysts).

The final question demonstrated the pervasiveness of the Spacing Effect and small but frequent learning sessions clearly were the means to benefit from this phenomenon.

5.2 Implications and Future Work

These are some of the implications observed during the study and have been embedded / incorporated into the future learning design at the partner organisation (SPOCE). These are generalisable and equally applicable to learning architects, consultants, practitioners, instruction designers, CLO, training & development departments engaged in designing learning initiatives for online management training in general and online project management training in particular involving adult audiences.

The online 24x7 web access, (as opposed to a CD-ROM/offline media or intranet based access) was identified as one of the single most important contributor to the learning initiative as is evident from the pattern of usage. (60% of the learning occurred outside core-office hours, over a fifth during late nights and weekends, 24% of the logins and logouts were outside office hours).

Encouraged by these results, future developments in this direction are envisaged including a robust platform for multi-channel access across the range of new categories of smart devices (tablet PC/Netbook/eReaders – Apple iPad, Amazon eKindle, etc; smart phones – Apple iPhone, Google android, Blackberry, etc). This therefore opens up avenues for future research work under multi-channel access.

Providing study access and time during working hours accelerated Time to Completion. On the other hand, studying during one's own time will require more time (more hours) to complete the learning as is evident from the statistically significant relationship between time spent - lunch break & non-core hours.

Learners with prior e-Learning experience do more during weekends. Similarly, individuals motivated by professional progression learn more during weekends which in turn contribute to a shorter Time to Completion.

Although, this study provided an unique insight into a real-time adult learning environment, the observations on some modalities and learning styles doing better than others could benefit from repeating the study under controlled conditions to further isolate and identify specific stimuli that contribute / deter the learning process.

The findings regarding the Spacing Effect raise some important questions on the traditional model with Intensive and rigorous massed learning events. The majority (over 80%) of training in the subject matter (PRINCE2® project management) is instructor lead intensive 5 day events. While their brevity and their intensive instruction / guidance just before the exam makes them popular, they prevent sufficient spacing (Rohrer & Pashler, 2007) and run the risk of producing deceptively high initial levels of learning followed by rapid forgetting.

Although stand-alone Follow through tools (Pereira et al. 2009), have evolved in an effort to fill this gap, they still remain a small niche. More widely used enterprise applications such as Virtual Learning Environments (VLEs), Learning Management Systems (LMS) & Knowledge / Talent / Performance Management Systems, etc might be better positioned and have a better opportunity to incorporate the benefits of the Spacing Effect in scheduling and sequencing study sessions in ways that optimise long term retention. (For example: Refresher courses, summary of previous learning and adaptive feedback)

While repetition and spaced practice are clearly the drivers to the Spacing Effect (Cepeda et al. 2006), questions remain regarding the nature and the construct of distributed / spaced practice and are ideal candidates for future research.

- Is there any merit to inter-sensory (Visual, Aural, Read / Write, Kinesthetic) repetitions?
- Will they contribute to improved recall / retention?
- Are they affected by individual cognitive style / preferences?
- Do these principles apply to higher order learning?

These observations were made under project management training in the public sector (UK) in an adult online learning environment. Therefore this study lends to

repeating to confirm in other environments. Researchers can explore repeating it using different sector (private sector), different content (other than project management), learners of a different culture, etc.

5.3 Conclusions

In this chapter, the results of the study were summarised and the contributions to the state of the art were discussed in the form of implications and recommendations for future work.

The purpose of this study was to provide unique insights into a real-life online project management learning environment. It aimed to explore the impact of modality preferences, learning style and usage pattern on learning completion, Time Spent & Time to Completion. Although the results of this study do indicate to modality preference and learning style being related to completions, time spent and time to completion; the results were not found to be statistically significant. Providing 24x7 access as well as time during working hours does accelerate the learning process. The study has also demonstrated the pervasiveness of the Spacing phenomenon and some support to the notion of general applicability (Dempster, 1987) of the Spacing Effect. Smaller more frequent learning instances spread over time are clearly more effective than the traditional single hit massed learning.

GLOSSARY

PRINCE2® is a methodology in project management. It is a best practice in project management and a defacto standard in the public sector (UK). The methodology is being widely adopted by the private sector and abroad.

PRINCE2® Passport is an accredited distance learning product for PRINCE2 project management developed by SPOCE Project Management Ltd., in partnership with Bournemouth University.

SPOCE is a training company in AMPG accredited methodologies (PRINCE2®, Managing Successful Programmes and Management of Risk).

KTP is a three way partnership between a company (SPOCE), university (Bournemouth University) and DTI (Department of Trade and Industry) for knowledge transfer. It is implemented through an associate (Clement).

eInnovation Scheme is a programme by the ODPM to encourage adoption of new technologies, new methodologies and innovative initiatives in the public sector. The key requirement being that, it should be a pioneering initiative in the public sector.

VARK - The acronym VARK stands for Visual, Aural, Read/write, and Kinesthetic sensory modalities that are used for learning information

Blooms Taxonomy

Knowledge: Recall data or information.

Comprehension: Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.

Application: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the work place.

Analysis: Separates material or concepts into component parts so that its organisational structure may be understood. Distinguishes between facts and inferences.

Synthesis: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.

Evaluation: Make judgments about the value of ideas or materials.

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APPENDICES

Appendix A: VARK Multi-Modal Variations

A:K	2	1.43%
A:K:R:V	2	1.43%
A:V:K:R	2	1.43%
A:V:R:K	1	0.71%
K:A:V	1	0.71%
K:A:V:R	2	1.43%
K:R	6	4.29%
K:R:A	1	0.71%
K:R:A:V	5	3.57%
K:R:V	1	0.71%
K:R:V:A	4	2.86%
K:V	4	2.86%
K:V:A:R	1	0.71%
K:V:R:A	1	0.71%
R:A	4	2.86%
R:A:K:V	6	4.29%
R:A:V:K	2	1.43%
R:K	3	2.14%
R:K:A	1	0.71%
R:K:A:V	2	1.43%
R:K:V	2	1.43%
R:V	3	2.14%
R:V:K	2	1.43%
R:V:K:A	4	2.86%
V:A:K	1	0.71%
V:K	1	0.71%
V:K:A:R	1	0.71%
V:R:K	2	1.43%

Appendix B: Phase 1 - One Way Annova analysis at the significance level of less than .001

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
UsageFrequency	Between Groups	17097.719	4	4274.430	27.220	.000
	Within Groups	21199.217	135	157.031		
	Total	38296.936	139			
TimeSpent(HH.MM)	Between Groups	5121.307	4	1280.327	14.596	.000
	Within Groups	11842.250	135	87.720		
	Total	16963.557	139			
Days	Between Groups	774375.378	4	193593.844	36.402	.000
	Within Groups	717957.494	135	5318.204		
	Total	1492332.872	139			
Overall Progress	Between Groups	106051.790	4	26512.947	60.280	.000
	Within Groups	59377.372	135	439.832		
	Total	165429.161	139			
SOverall_Score	Between Groups	85248.840	4	21312.210	26.249	.000
	Within Groups	109611.353	135	811.936		
	Total	194860.192	139			
SPRINCE_Test	Between Groups	60809.179	4	15202.295	31.675	.000
	Within Groups	64792.764	135	479.946		
	Total	125601.944	139			
NOffHLogins	Between Groups	742.253	4	185.563	8.276	.000
	Within Groups	3026.919	135	22.422		
	Total	3769.171	139			
NOffHLogouts	Between Groups	764.948	4	191.237	8.435	.000
	Within Groups	3060.845	135	22.673		
	Total	3825.793	139			
NOffHTSHH.MM	Between Groups	345.392	4	86.348	5.541	.000
	Within Groups	2103.601	135	15.582		
	Total	2448.993	139			
MornCore OfficeTS10:12AM	Between Groups	2435838335.432	4	608959583.858	9.501	.000

	Within Groups	8652393868.541	135	64091806.434		
	Total	11088232203.972	139			
LunchBreakTS12:14PM	Between Groups	1620645050.519	4	405161262.630	5.727	.000
	Within Groups	9550283428.653	135	70742840.212		
	Total	11170928479.172	139			
NoonCoreOfficeTS14:16PM	Between Groups	3843302634.855	4	960825658.714	9.285	.000
	Within Groups	13969957190.318	135	103481164.373		
	Total	17813259825.172	139			
EvenTwilightTS16:19PM	Between Groups	1189140000.998	4	297285000.250	7.061	.000
	Within Groups	5683923684.852	135	42103138.406		
	Total	6873063685.850	139			
NonCoreHrs	Between Groups	10976631939.444	4	2744157984.861	12.217	.000
	Within Groups	30322390702.100	135	224610301.497		
	Total	41299022641.543	139			
AvgStudyTime	Between Groups	115718761.386	4	28929690.346	10.927	.000
	Within Groups	357428266.967	135	2647616.792		
	Total	473147028.353	139			

Appendix C: Phase 1 – Scheffe Multiple Comparisons

Multiple Comparisons

Scheffe

Dependent Variable	(I) UserStatus	(J) UserStatus	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
UsageFrequency	UnInitiated	Non-Starter	-1.444	4.763	.999	-16.32	13.43
		Drop-Out	-10.833	4.280	.178	-24.20	2.54
		In-Process	-11.377(*)	2.794	.003	-20.10	-2.65
		Completed	-32.500(*)	3.293	.000	-42.78	-22.22
	Non-Starter	UnInitiated	1.444	4.763	.999	-13.43	16.32
		Drop-Out	-9.389	5.526	.579	-26.65	7.87
		In-Process	-9.933	4.475	.300	-23.91	4.04
		Completed	-31.056(*)	4.802	.000	-46.05	-16.06
	Drop-Out	UnInitiated	10.833	4.280	.178	-2.54	24.20
		Non-Starter	9.389	5.526	.579	-7.87	26.65
		In-Process	-.544	3.957	1.000	-12.90	11.82
		Completed	-21.667(*)	4.324	.000	-35.17	-8.16
	In-Process	UnInitiated	11.377(*)	2.794	.003	2.65	20.10
		Non-Starter	9.933	4.475	.300	-4.04	23.91
		Drop-Out	.544	3.957	1.000	-11.82	12.90
		Completed	-21.123(*)	2.861	.000	-30.06	-12.19
	Completed	UnInitiated	32.500(*)	3.293	.000	22.22	42.78
		Non-Starter	31.056(*)	4.802	.000	16.06	46.05
		Drop-Out	21.667(*)	4.324	.000	8.16	35.17
		In-Process	21.123(*)	2.861	.000	12.19	30.06
TimeSpent (HH.MM)	UnInitiated	Non-Starter	-.444	3.560	1.000	-11.56	10.67
		Drop-Out	-5.848	3.199	.505	-15.84	4.14
		In-Process	-6.244	2.089	.069	-12.77	.28
		Completed	-17.723(*)	2.461	.000	-25.41	-10.04
	Non-Starter	UnInitiated	.444	3.560	1.000	-10.67	11.56
		Drop-Out	-5.404	4.130	.788	-18.30	7.50
		In-Process	-5.800	3.344	.558	-16.25	4.65
		Completed	-17.279(*)	3.589	.000	-28.49	-6.07

	Drop-Out	UnInitiated	5.848	3.199	.505	-4.14	15.84
		Non-Starter	5.404	4.130	.788	-7.50	18.30
		In-Process	-.396	2.958	1.000	-9.63	8.84
		Completed	-11.875(*)	3.232	.011	-21.97	-1.78
	In-Process	UnInitiated	6.244	2.089	.069	-.28	12.77
		Non-Starter	5.800	3.344	.558	-4.65	16.25
		Drop-Out	.396	2.958	1.000	-8.84	9.63
		Completed	-11.479(*)	2.138	.000	-18.16	-4.80
	Completed	UnInitiated	17.723(*)	2.461	.000	10.04	25.41
		Non-Starter	17.279(*)	3.589	.000	6.07	28.49
		Drop-Out	11.875(*)	3.232	.011	1.78	21.97
		In-Process	11.479(*)	2.138	.000	4.80	18.16
Days	UnInitiated	Non-Starter	-5.66667	27.71615	1.000	-92.2323	80.8990
		Drop-Out	-35.56583	24.90898	.729	-113.3639	42.2322
		In-Process	-66.33508(*)	16.26214	.003	-117.1265	-15.5437
		Completed	-213.76000(*)	19.16271	.000	-273.6107	-153.9093
	Non-Starter	UnInitiated	5.66667	27.71615	1.000	-80.8990	92.2323
		Drop-Out	-29.89917	32.15735	.929	-130.3360	70.5376
		In-Process	-60.66842	26.04026	.252	-141.9998	20.6629
		Completed	-208.09333(*)	27.94365	.000	-295.3695	-120.8171
	Drop-Out	UnInitiated	35.56583	24.90898	.729	-42.2322	113.3639
		Non-Starter	29.89917	32.15735	.929	-70.5376	130.3360
		In-Process	-30.76925	23.02970	.775	-102.6978	41.1593
		Completed	-178.19417(*)	25.16187	.000	-256.7820	-99.6063
	In-Process	UnInitiated	66.33508(*)	16.26214	.003	15.5437	117.1265

		Non-Starter	60.66842	26.04026	.252	-20.6629	141.9998
		Drop-Out	30.76925	23.02970	.775	-41.1593	102.6978
		Completed	-147.42492(*)	16.64691	.000	-199.4181	-95.4318
	Completed	UnInitiated	213.76000(*)	19.16271	.000	153.9093	273.6107
		Non-Starter	208.09333(*)	27.94365	.000	120.8171	295.3695
		Drop-Out	178.19417(*)	25.16187	.000	99.6063	256.7820
		In-Process	147.42492(*)	16.64691	.000	95.4318	199.4181
Overall Progress	UnInitiated	Non-Starter	-3.58222	7.97066	.995	-28.4769	21.3125
		Drop-Out	-31.87750(*)	7.16336	.001	-54.2508	-9.5042
		In-Process	-22.49541(*)	4.67669	.000	-37.1021	-7.8887
		Completed	-79.82786(*)	5.51084	.000	-97.0398	-62.6159
	Non-Starter	UnInitiated	3.58222	7.97066	.995	-21.3125	28.4769
		Drop-Out	-28.29528	9.24786	.058	-57.1791	.5885
		In-Process	-18.91319	7.48870	.179	-42.3026	4.4762
		Completed	-76.24563(*)	8.03608	.000	-101.3447	-51.1466
	Drop-Out	UnInitiated	31.87750(*)	7.16336	.001	9.5042	54.2508
		Non-Starter	28.29528	9.24786	.058	-.5885	57.1791
		In-Process	9.38209	6.62292	.735	-11.3032	30.0674
		Completed	-47.95036(*)	7.23609	.000	-70.5508	-25.3499

	In-Process	UnInitiated	22.49541(*)	4.67669	.000	7.8887	37.1021
		Non-Starter	18.91319	7.48870	.179	-4.4762	42.3026
		Drop-Out	-9.38209	6.62292	.735	-30.0674	11.3032
		Completed	-57.33245(*)	4.78734	.000	-72.2847	-42.3802
	Completed	UnInitiated	79.82786(*)	5.51084	.000	62.6159	97.0398
		Non-Starter	76.24563(*)	8.03608	.000	51.1466	101.3447
		Drop-Out	47.95036(*)	7.23609	.000	25.3499	70.5508
		In-Process	57.33245(*)	4.78734	.000	42.3802	72.2847
SOverall_Score	UnInitiated	Non-Starter	-17.522	10.830	.625	-51.35	16.30
		Drop-Out	-29.616	9.733	.061	-60.01	.78
		In-Process	-31.829(*)	6.354	.000	-51.67	-11.98
		Completed	-75.352(*)	7.487	.000	-98.74	-51.97
	Non-Starter	UnInitiated	17.522	10.830	.625	-16.30	51.35
		Drop-Out	-12.094	12.565	.920	-51.34	27.15
		In-Process	-14.307	10.175	.740	-46.09	17.47
		Completed	-57.830(*)	10.918	.000	-91.93	-23.73
	Drop-Out	UnInitiated	29.616	9.733	.061	-.78	60.01
		Non-Starter	12.094	12.565	.920	-27.15	51.34
		In-Process	-2.213	8.998	1.000	-30.32	25.89
		Completed	-45.736(*)	9.832	.000	-76.44	-15.03
	In-Process	UnInitiated	31.829(*)	6.354	.000	11.98	51.67
		Non-Starter	14.307	10.175	.740	-17.47	46.09
		Drop-Out	2.213	8.998	1.000	-25.89	30.32
		Completed	-43.523(*)	6.504	.000	-63.84	-23.21
	Completed	UnInitiated	75.352(*)	7.487	.000	51.97	98.74
		Non-Starter	57.830(*)	10.91	.000	23.73	91.93

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		Drop-Out	45.736(*)	9.832	.000	15.03	76.44
		In-Process	43.523(*)	6.504	.000	23.21	63.84
SPRINCE_Test	UnInitiated	Non-Starter	.000	8.326	1.000	-26.01	26.01
		Drop-Out	-11.333	7.483	.682	-34.70	12.04
		In-Process	-8.787	4.885	.522	-24.05	6.47
		Completed	-57.143(*)	5.757	.000	-75.12	-39.16
	Non-Starter	UnInitiated	.000	8.326	1.000	-26.01	26.01
		Drop-Out	-11.333	9.660	.848	-41.51	18.84
		In-Process	-8.787	7.823	.867	-33.22	15.65
		Completed	-57.143(*)	8.395	.000	-83.36	-30.92
	Drop-Out	UnInitiated	11.333	7.483	.682	-12.04	34.70
		Non-Starter	11.333	9.660	.848	-18.84	41.51
		In-Process	2.546	6.918	.998	-19.06	24.15
		Completed	-45.810(*)	7.559	.000	-69.42	-22.20
	In-Process	UnInitiated	8.787	4.885	.522	-6.47	24.05
		Non-Starter	8.787	7.823	.867	-15.65	33.22
		Drop-Out	-2.546	6.918	.998	-24.15	19.06
		Completed	-48.356(*)	5.001	.000	-63.98	-32.74
	Completed	UnInitiated	57.143(*)	5.757	.000	39.16	75.12
		Non-Starter	57.143(*)	8.395	.000	30.92	83.36
		Drop-Out	45.810(*)	7.559	.000	22.20	69.42
		In-Process	48.356(*)	5.001	.000	32.74	63.98
NOffHLogins	UnInitiated	Non-Starter	-.111	1.800	1.000	-5.73	5.51
		Drop-Out	-.500	1.617	.999	-5.55	4.55
		In-Process	-2.361	1.056	.293	-5.66	.94
		Completed	-6.536(*)	1.244	.000	-10.42	-2.65
	Non-Starter	UnInitiated	.111	1.800	1.000	-5.51	5.73
		Drop-Out	-.389	2.088	1.000	-6.91	6.13
		In-Process	-2.250	1.691	.778	-7.53	3.03
		Completed	-6.425(*)	1.814	.017	-12.09	-.76
	Drop-Out	UnInitiated	.500	1.617	.999	-4.55	5.55
		Non-Starter	.389	2.088	1.000	-6.13	6.91
		In-Process	-1.861	1.495	.818	-6.53	2.81
		Completed	-6.036(*)	1.634	.011	-11.14	-.93
	In-Process	UnInitiated	2.361	1.056	.293	-.94	5.66
		Non-Starter	2.250	1.691	.778	-3.03	7.53
		Drop-Out	1.861	1.495	.818	-2.81	6.53

		Completed	-4.175(*)	1.081	.007	-7.55	-.80
	Completed	UnInitiated	6.536(*)	1.244	.000	2.65	10.42
		Non-Starter	6.425(*)	1.814	.017	.76	12.09
		Drop-Out	6.036(*)	1.634	.011	.93	11.14
		In-Process	4.175(*)	1.081	.007	.80	7.55
NOffHLogouts	UnInitiated	Non-Starter	-.111	1.810	1.000	-5.76	5.54
		Drop-Out	-.417	1.626	.999	-5.50	4.66
		In-Process	-2.164	1.062	.390	-5.48	1.15
		Completed	-6.607(*)	1.251	.000	-10.52	-2.70
	Non-Starter	UnInitiated	.111	1.810	1.000	-5.54	5.76
		Drop-Out	-.306	2.100	1.000	-6.86	6.25
		In-Process	-2.053	1.700	.834	-7.36	3.26
		Completed	-6.496(*)	1.825	.016	-12.19	-.80
	Drop-Out	UnInitiated	.417	1.626	.999	-4.66	5.50
		Non-Starter	.306	2.100	1.000	-6.25	6.86
		In-Process	-1.747	1.504	.852	-6.44	2.95
		Completed	-6.190(*)	1.643	.009	-11.32	-1.06
	In-Process	UnInitiated	2.164	1.062	.390	-1.15	5.48
		Non-Starter	2.053	1.700	.834	-3.26	7.36
		Drop-Out	1.747	1.504	.852	-2.95	6.44
		Completed	-4.443(*)	1.087	.003	-7.84	-1.05
	Completed	UnInitiated	6.607(*)	1.251	.000	2.70	10.52
		Non-Starter	6.496(*)	1.825	.016	.80	12.19
		Drop-Out	6.190(*)	1.643	.009	1.06	11.32
		In-Process	4.443(*)	1.087	.003	1.05	7.84
NOffHTSHH.MM	UnInitiated	Non-Starter	-.023	1.500	1.000	-4.71	4.66
		Drop-Out	-.047	1.348	1.000	-4.26	4.16
		In-Process	-.791	.880	.937	-3.54	1.96
		Completed	-4.268(*)	1.037	.003	-7.51	-1.03
	Non-Starter	UnInitiated	.023	1.500	1.000	-4.66	4.71
		Drop-Out	-.023	1.741	1.000	-5.46	5.41
		In-Process	-.768	1.410	.990	-5.17	3.63
		Completed	-4.245	1.513	.103	-8.97	.48
	Drop-Out	UnInitiated	.047	1.348	1.000	-4.16	4.26
		Non-Starter	.023	1.741	1.00	-5.41	5.46

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		In-Process	-.745	1.247	.986	-4.64	3.15
		Completed	-4.222	1.362	.053	-8.48	.03
	In-Process	UnInitiated	.791	.880	.937	-1.96	3.54
		Non-Starter	.768	1.410	.990	-3.63	5.17
		Drop-Out	.745	1.247	.986	-3.15	4.64
		Completed	-3.477(*)	.901	.007	-6.29	-.66
	Completed	UnInitiated	4.268(*)	1.037	.003	1.03	7.51
		Non-Starter	4.245	1.513	.103	-.48	8.97
		Drop-Out	4.222	1.362	.053	-.03	8.48
		In-Process	3.477(*)	.901	.007	.66	6.29
MornCore OfficeTS10:12AM	UnInitiated	Non-Starter	-521.444	3042.648	1.000	-10024.52	8981.63
		Drop-Out	-6037.000	2734.479	.306	-14577.58	2503.58
		In-Process	-4955.803	1785.239	.110	-10531.63	620.02
		Completed	-12310.607(*)	2103.660	.000	-18880.95	-5740.26
	Non-Starter	UnInitiated	521.444	3042.648	1.000	-8981.63	10024.52
		Drop-Out	-5515.556	3530.198	.656	-16541.40	5510.28
		In-Process	-4434.359	2858.671	.662	-13362.82	4494.11
		Completed	-11789.163(*)	3067.622	.007	-21370.24	-2208.08
	Drop-Out	UnInitiated	6037.000	2734.479	.306	-2503.58	14577.58
		Non-Starter	5515.556	3530.198	.656	-5510.28	16541.40
		In-Process	1081.197	2528.175	.996	-6815.03	8977.43
		Completed	-6273.607	2762.241	.277	-14900.90	2353.68
	In-Process	UnInitiated	4955.803	1785.239	.110	-620.02	10531.63
		Non-Starter	4434.359	2858.671	.662	-4494.11	13362.82
		Drop-Out	-1081.197	2528.175	.996	-8977.43	6815.03

		Completed	-7354.804(*)	1827.479	.004	-13062.55	-1647.05
	Completed	UnInitiated	12310.607(*)	2103.660	.000	5740.26	18880.95
		Non-Starter	11789.163(*)	3067.622	.007	2208.08	21370.24
		Drop-Out	6273.607	2762.241	.277	-2353.68	14900.90
		In-Process	7354.804(*)	1827.479	.004	1647.05	13062.55
LunchBreakTS12:14PM	UnInitiated	Non-Starter	-586.444	3196.625	1.000	-10570.44	9397.55
		Drop-Out	-4648.667	2872.861	.625	-13621.45	4324.12
		In-Process	-4744.557	1875.583	.178	-10602.55	1113.44
		Completed	-10078.786(*)	2210.119	.001	-16981.63	-3175.94
	Non-Starter	UnInitiated	586.444	3196.625	1.000	-9397.55	10570.44
		Drop-Out	-4062.222	3708.848	.878	-15646.04	7521.59
		In-Process	-4158.113	3003.337	.751	-13538.41	5222.19
		Completed	-9492.341	3222.863	.076	-19558.29	573.60
	Drop-Out	UnInitiated	4648.667	2872.861	.625	-4324.12	13621.45
		Non-Starter	4062.222	3708.848	.878	-7521.59	15646.04
		In-Process	-95.891	2656.117	1.000	-8391.72	8199.94
		Completed	-5430.119	2902.028	.481	-14494.00	3633.76
	In-Process	UnInitiated	4744.557	1875.583	.178	-1113.44	10602.55
		Non-Starter	4158.113	3003.337	.751	-5222.19	13538.41
		Drop-Out	95.891	2656.117	1.000	-8199.94	8391.72
		Completed	-5334.228	1919.	.109	-11330.83	662.37

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	Completed	UnInitiated	10078.786(*)	2210.119	.001	3175.94	16981.63
		Non-Starter	9492.341	3222.863	.076	-573.60	19558.29
		Drop-Out	5430.119	2902.028	.481	-3633.76	14494.00
		In-Process	5334.228	1919.961	.109	-662.37	11330.83
NoonCore OfficeTS1 4:16PM	UnInitiated	Non-Starter	-886.556	3866.171	1.000	-12961.74	11188.63
		Drop-Out	-6598.750	3474.594	.465	-17450.92	4253.42
		In-Process	-6111.066	2268.432	.130	-13196.04	973.91
		Completed	-15532.679(*)	2673.037	.000	-23881.36	-7184.00
	Non-Starter	UnInitiated	886.556	3866.171	1.000	-11188.63	12961.74
		Drop-Out	-5712.194	4485.681	.805	-19722.29	8297.90
		In-Process	-5224.510	3632.399	.723	-16569.55	6120.53
		Completed	-14646.123(*)	3897.905	.009	-26820.42	-2471.83
	Drop-Out	UnInitiated	6598.750	3474.594	.465	-4253.42	17450.92
		Non-Starter	5712.194	4485.681	.805	-8297.90	19722.29
		In-Process	487.684	3212.451	1.000	-9545.74	10521.11
		Completed	-8933.929	3509.870	.173	-19896.28	2028.42
	In-Process	UnInitiated	6111.066	2268.432	.130	-973.91	13196.04
		Non-Starter	5224.510	3632.399	.723	-6120.53	16569.55
		Drop-Out	-487.684	3212.451	1.000	-10521.11	9545.74
		Completed	-9421.613(*	2322.104	.004	-16674.22	-2169.00

			)				
	Completed	UnInitiated	15532.679(*)	2673.037	.000	7184.00	23881.36
		Non-Starter	14646.123(*)	3897.905	.009	2471.83	26820.42
		Drop-Out	8933.929	3509.870	.173	-2028.42	19896.28
		In-Process	9421.613(*)	2322.104	.004	2169.00	16674.22
EvenTwilightTS16:19 PM	UnInitiated	Non-Starter	.000	2466.083	1.000	-7702.30	7702.30
		Drop-Out	-2657.333	2216.311	.837	-9579.52	4264.85
		In-Process	-3178.377	1446.946	.311	-7697.61	1340.86
		Completed	-8505.071(*)	1705.028	.000	-13830.37	-3179.77
	Non-Starter	UnInitiated	.000	2466.083	1.000	-7702.30	7702.30
		Drop-Out	-2657.333	2861.245	.929	-11593.84	6279.17
		In-Process	-3178.377	2316.968	.757	-10414.95	4058.19
		Completed	-8505.071(*)	2486.325	.023	-16270.59	-739.55
	Drop-Out	UnInitiated	2657.333	2216.311	.837	-4264.85	9579.52
		Non-Starter	2657.333	2861.245	.929	-6279.17	11593.84
		In-Process	-521.044	2049.100	.999	-6920.98	5878.89
		Completed	-5847.738	2238.812	.152	-12840.20	1144.73
	In-Process	UnInitiated	3178.377	1446.946	.311	-1340.86	7697.61
		Non-Starter	3178.377	2316.968	.757	-4058.19	10414.95
		Drop-Out	521.044	2049.100	.999	-5878.89	6920.98
		Completed	-5326.694(*	1481.182	.014	-9952.86	-700.53

			)				
	Completed	UnInitiated	8505.071(*)	1705.028	.000	3179.77	13830.37
		Non-Starter	8505.071(*)	2486.325	.023	739.55	16270.59
		Drop-Out	5847.738	2238.812	.152	-1144.73	12840.20
		In-Process	5326.694(*)	1481.182	.014	700.53	9952.86
NonCoreHrs	UnInitiated	Non-Starter	-163.33333	5695.93805	1.000	-17953.4147	17626.7480
		Drop-Out	-4438.66667	5119.03655	.944	-20426.9158	11549.5825
		In-Process	-7399.59016	3342.02725	.303	-17837.7193	3038.5389
		Completed	-25314.39286(*)	3938.12221	.000	-37614.3009	-13014.4848
	Non-Starter	UnInitiated	163.33333	5695.93805	1.000	-17626.7480	17953.4147
		Drop-Out	-4275.33333	6608.64777	.981	-24916.0742	16365.4075
		In-Process	-7236.25683	5351.52654	.767	-23950.6402	9478.1266
		Completed	-25151.05952(*)	5742.69072	.001	-43087.1631	-7214.9559
	Drop-Out	UnInitiated	4438.66667	5119.03655	.944	-11549.5825	20426.9158
		Non-Starter	4275.33333	6608.64777	.981	-16365.4075	24916.0742
		In-Process	-2960.92350	4732.82804	.983	-17742.9304	11821.0834
		Completed	-20875.72619(*)	5171.00779	.004	-37026.2967	-4725.1556
	In-Process	UnInitiated	7399.59016	3342.02725	.303	-3038.5389	17837.7193
		Non-Starter	7236.2568	5351.	.767	-9478.1266	23950.6402

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		Drop-Out	2960.92350	4732.82804	.983	-11821.0834	17742.9304
		Completed	-17914.80269(*)	3421.10108	.000	-28599.9025	-7229.7029
	Completed	UnInitiated	25314.39286(*)	3938.12221	.000	13014.4848	37614.3009
		Non-Starter	25151.05952(*)	5742.69072	.001	7214.9559	43087.1631
		Drop-Out	20875.72619(*)	5171.00779	.004	4725.1556	37026.2967
		In-Process	17914.80269(*)	3421.10108	.000	7229.7029	28599.9025
AvgStudyTime	UnInitiated	Non-Starter	-1290.0556	618.4121	.365	-3221.538	641.426
		Drop-Out	-2638.7382(*)	555.7775	.000	-4374.594	-902.882
		In-Process	-1745.2304(*)	362.8463	.000	-2878.506	-611.955
		Completed	-2524.1195(*)	427.5648	.000	-3859.529	-1188.710
	Non-Starter	UnInitiated	1290.0556	618.4121	.365	-641.426	3221.538
		Drop-Out	-1348.6826	717.5057	.476	-3589.663	892.298
		In-Process	-455.1748	581.0191	.961	-2269.868	1359.518
		Completed	-1234.0640	623.4881	.421	-3181.400	713.272
	Drop-Out	UnInitiated	2638.7382(*)	555.7775	.000	902.882	4374.594
		Non-Starter	1348.6826	717.5057	.476	-892.298	3589.663
		In-Process	893.5078	513.8466	.556	-711.385	2498.401
		Completed	114.6187	561.4201	1.000	-1638.860	1868.098
	In-Process	UnInitiated	1745.2304(*)	362.8463	.000	611.955	2878.506
		Non-Starter	455.1748	581.0	.961	-1359.518	2269.868

		Drop-Out	-893.5078	191513.8466	.556	-2498.401	711.385
		Completed	-778.8892	371.4314	.360	-1938.978	381.200
	Completed	UnInitiated	2524.1195(*)	427.5648	.000	1188.710	3859.529
		Non-Starter	1234.0640	623.4881	.421	-713.272	3181.400
		Drop-Out	-114.6187	561.4201	1.000	-1868.098	1638.860
		In-Process	778.8892	371.4314	.360	-381.200	1938.978

* The mean difference is significant at the .05 level.

Appendix D: Phase 1 – Completed Users - Correlation between learning attributes

		UsageFrequency	TimeSpentRaw	WeekendTSRaw	AvgStudyTime	AvgTimeBetweenLogins	
Obj:A1	Pearson Correlation	.070	.070	.287	-.133	.002	
	Sig. (2-tailed)	.724	.723	.139	.501	.992	
	N	28	28	28	28	28	
Obj:A2	Pearson Correlation	.212	-.140	-.131	-.224	-.050	
	Sig. (2-tailed)	.280	.478	.506	.253	.799	
	N	28	28	28	28	28	
Obj:A3	Pearson Correlation	-.445(*)	-.106	-.049	.256	.153	
	Sig. (2-tailed)	.018	.591	.803	.189	.437	
	N	28	28	28	28	28	
Obj:A4	Pearson Correlation	-.190	-.295	-.112	-.123	.412(*)	
	Sig. (2-tailed)	.333	.127	.572	.533	.029	
	N	28	28	28	28	28	
Obj:A5	Pearson Correlation	.284	.422(*)	.783(**)	.004	-.109	
	Sig. (2-tailed)	.143	.025	.000	.984	.580	
	N	28	28	28	28	28	
KD:A1	Pearson Correlation	.059	.248	.443(*)	.103	-.231	
	Sig. (2-tailed)	.767	.203	.018	.601	.237	
	N	28	28	28	28	28	
KD:A2	Pearson Correlation	-.074	.064	.408(*)	-.024	.193	
	Sig. (2-tailed)	.710	.747	.031	.902	.326	
	N	28	28	28	28	28	
KD:A3	Pearson Correlation	-.004	.140	.421(*)	.129	.056	
	Sig. (2-tailed)	.985	.478	.026	.514	.779	
	N	28	28	28	28	28	
KD:A4	Pearson Correlation	-.326	-.004	.191	.175	.132	
	Sig. (2-tailed)	.091	.983	.331	.372	.504	
	N	28	28	28	28	28	
KD:A5	Pearson	.(a)	.(a)	.(a)	.(a)	.(a)	

	Correlation					
	Sig. (2-tailed)	.	.	.	.	.
	N	28	28	28	28	28
KD:A6	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.	.	.
	N	28	28	28	28	28
AL:A1	Pearson Correlation	.180	.052	.404(*)	-.132	.104
	Sig. (2-tailed)	.359	.794	.033	.504	.600
	N	28	28	28	28	28
AL:A2	Pearson Correlation	.164	.262	-.062	.022	-.140
	Sig. (2-tailed)	.404	.179	.754	.913	.477
	N	28	28	28	28	28
AL:A3	Pearson Correlation	-.320	-.206	-.218	.125	-.061
	Sig. (2-tailed)	.096	.293	.266	.527	.760
	N	28	28	28	28	28
AL:A4	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.	.	.
	N	28	28	28	28	28
PE:A1	Pearson Correlation	.108	.571(**)	.815(**)	.486(**)	-.162
	Sig. (2-tailed)	.586	.002	.000	.009	.411
	N	28	28	28	28	28
PE:A2	Pearson Correlation	-.293	-.137	.010	-.010	.408(*)
	Sig. (2-tailed)	.131	.488	.962	.960	.031
	N	28	28	28	28	28
PE:A3	Pearson Correlation	.205	-.202	-.473(*)	-.268	-.279
	Sig. (2-tailed)	.297	.304	.011	.168	.151
	N	28	28	28	28	28
PE:A4	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.	.	.
	N	28	28	28	28	28

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

a Cannot be computed because at least one of the variables is constant.

Appendix E: Phase 2 – Completed Users – descriptive statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
User	100	3	222	109.87	65.974
Overall Progress	100	3.15	90.85	74.9962	21.86524
PRINCE_Test	100	.00	100.00	55.5069	31.06477
Overall_Score	100	.00	98.31	71.4725	20.26671
V	100	0	1	.49	.502
A	100	0	1	.50	.503
R	100	0	1	.71	.456
K	100	0	1	.69	.465
CSI	34	14	60	39.94	10.854
Intuitives	34	0	1	.41	.500
Intermediate	34	0	1	.32	.475
Analyst	34	0	1	.26	.448
CSI_Status	34	1	3	1.85	.821
CSI_MedianStatus	34	1	2	1.41	.500
Male	34	0	1	.56	.504
Female	34	0	1	.44	.504
Age	34	23	57	40.85	7.878
Usage Frequency	100	3	126	33.71	20.982
First Login	100	10-MAR-2005 14:04:06.00	25-MAY-2007 09:21:03.00	10-MAR-2006 08:01:39.53	186 09:14:16.62708
Last Login	100	01-DEC-2005 12:03:56.00	11-JUL-2007 11:35:33.00	21-NOV-2006 18:33:08.71	167 21:03:57.54433
Days	100	33	661	231.66	121.306
T2C	100	0	661	230.71	122.810
NOffH Logins	100	0	45	8.94	9.891
NOffH Logouts	100	0	45	8.61	9.998
Time Spent (HH.MM)	100	1282	264536 73.48	69336.84 19.26	54288.599
Weekend TS HH.MM	100	0	185718	9068.29	23049.904
Morn Twilight TS 08:10AM	100	0	30122	5473.66	7894.724
Morn Core Office TS 10:12AM	100	0	66754	12957.82	13511.933

Lunch Break TS 12:14PM	100	0	54623	10883.86	12476.377
Noon Core Office TS 14:16PM	100	0	88176	14573.07	16555.777
Even Twilight TS 16:19PM	100	0	81251	8841.79	13065.041
Night TS 19:08AM	100	0	67364	7538.35	12266.694
Avg Study Time	100	98.78	9179.86	2331.9923	1683.68210
Avg Time Between Logins	100	.02	152.27	14.6986	19.83429
NoLogins	100	0	0	.00	.000
NonStarters	100	0	0	.00	.000
DropOuts	100	0	0	.00	.000
InProcess	100	0	0	.00	.000
Completions	100	1	2	1.04	.197
Prg_Status	100	5	5	5.00	.000
Obj:A1	100	0	1	.20	.402
Obj:A2	100	0	1	.56	.499
Obj:A3	100	0	1	.62	.488
Obj:A4	100	0	1	.10	.302
Obj:A5	100	0	1	.02	.141
KD:A1	100	0	1	.31	.465
KD:A2	100	0	1	.23	.423
KD:A3	100	0	1	.46	.501
KD:A4	100	0	1	.74	.441
KD:A5	100	0	1	.04	.197
KD:A6	100	0	1	.02	.141
TB:Wks	100	0	56	14.14	8.917
TB:Hrs	100	0	21	3.86	2.865
AL:A1	100	0	1	.30	.461
AL:A2	100	0	1	.31	.465
AL:A3	100	0	1	.50	.503
AL:A4	100	0	1	.01	.100
PE:A1	100	0	1	.08	.273
PE:A2	100	0	1	.22	.416
PE:A3	100	0	1	.70	.461
PE:A4	100	0	1	.01	.100
Valid N (listwise)	34				

Appendix F: Phase 2 – Regression Analysis

Variables Entered / Removed (b)

Model	Variables Entered	Variables Removed	Method
1	Avg. Time Between Logins, Avg. Study Time, Usage Frequency(a)	.	Enter

a All requested variables entered.
b Dependent Variable: Time Spent

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.876(a)	.768	.761	26560.023

a Predictors: (Constant), Avg. Time Between Logins, Avg. Study Time, Usage Frequency

ANOVA (b)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	224056203774.195	3	74685401258.065	105.871	.000(a)
	Residual	67721745133.246	96	705434845.138		
	Total	291777948907.440	99			

a Predictors: (Constant), Avg. Time Between Logins, Avg. Study Time, Usage Frequency
b Dependent Variable: Time Spent

Coefficients (a)

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-30627.131	8140.332		-3.762	.000
	Usage Frequency	1463.861	146.201	.566	10.013	.000
	Avg. Study Time	25.155	1.656	.780	15.190	.000
	Avg. Time Between Logins	-547.192	152.637	-.200	-3.585	.001

a Dependent Variable: Time Spent

Appendix G: Pre-learning Questionnaire

Pre - Course Questionnaire

Choose the answer which best explains your preference and click on the check box against your preference. Please select more than one response if a single answer does not match your perception.

Your responses to this questionnaire will be used for research purposes only.

- **Objectives**
  What are your objectives for taking this course?

  - ☐ Requirement of your job
  - ☐ Relevant to your job profile
  - ☐ Useful to your job
  - ☐ Because, it is available
  - ☐ Other (Please Specify) _____

- **Key Drivers**
  What are your drivers for taking up this course?

  - ☐ Professional Upgrading
  - ☐ Industry Certification
  - ☐ Good addition to resume
  - ☐ Contribute to professional progression
  - ☐ Mandated by the Training function
  - ☐ Other (Please Specify) _____

- **Time Budgeted**
  What is your planned time scale to complete the course (weeks)?

  _____

- How many hours do you intend to dedicate to the course (per week)?

  _____

- **Approach** to Learning

  - ☐ Time budget
  - ☐ Learning plan

- ☐ Adhoc
- ☐ Other (Please Specify) _____

- **Prior experience** with e-learning (CBT/WBT)

  - ☐ Lead to Formal Qualification
  - ☐ Informal learning
  - ☐ Never
  - ☐ Other (Please Specify) _____

Appendix H: VARK Questionnaire

The VARK Questionnaire

(Visual, Aural, Read/Write, Kinesthetic, Multimodal)

How Do We Learn Best?

This questionnaire aims to find out something about our preferences for the way we work with information. Every individual has a preferred learning style and one part of that learning style is our preference for the intake and output of ideas and information.

Choose the answer which best explains your preference and click on the check box against your preference. Please select more than one response if a single answer does not match your perception.

Your responses to this questionnaire will be used for research purposes only.

- You are about to give directions to a person who is standing with you. She is staying in a hotel in town and wants to visit your house later. She has a rental car. I would:

  - ☐ draw a map on paper.
  - ☐ tell her the directions.
  - ☐ write down the directions (without a map)
  - ☐ collect her from the hotel in a car.
  - ☐ does not apply

- You are not sure whether a word should be spelled 'dependent' or 'dependant'. I would:

  - ☐ look it up in the dictionary.
  - ☐ see the word in my mind and choose by the way it looks
  - ☐ sound it out in my mind.
  - ☐ write both versions down on paper and choose one.
  - ☐ does not apply

- You have just received a copy of your itinerary for a world trip. This is of interest to a friend. I would:

  - ☐ phone her immediately and tell her about it.
  - ☐ send her a copy of the printed itinerary.
  - ☐ show her on a map of the world.
  - ☐ share what I plan to do at each place I visit.

- ☐ does not apply

- You are going to cook something as a special treat for your family. I would:

  - ☐ cook something familiar without the need for instructions.
  - ☐ thumb through the cookbook looking for ideas from the pictures.
  - ☐ refer to a specific cookbook where there is a good recipe.
  - ☐ does not apply

- A group of tourists has been assigned to you to find out about wildlife reserves or parks. I would:

  - ☐ drive them to a wildlife reserve or park.
  - ☐ show them slides and photographs
  - ☐ give them pamphlets or a book on wildlife reserves or parks.
  - ☐ give them a talk on wildlife reserves or parks.

- You are about to purchase a new CD player. Other than price, what would most influence your decision?

  - ☐ the salesperson telling you what you want to know.
  - ☐ reading the details about it.
  - ☐ playing with the controls and listening to it.
  - ☐ it looks really smart and fashionable.

- Recall a time in your life when you learned how to do something like playing a new board game. Try to avoid choosing a very physical skill, e.g. riding a bike. I learnt best by:

  - ☐ visual clues -- pictures, diagrams, charts
  - ☐ written instructions.
  - ☐ listening to somebody explaining it.
  - ☐ doing it or trying it.

- You have an eye problem. I would prefer that the doctor:

  - ☐ told me what was wrong.
  - ☐ showed me a diagram of what was wrong.
  - ☐ used a model to show me what was wrong.

- You are about to learn to use a new program on a computer. I would:

  - ☐ sit down at the keyboard and begin to experiment with the program's features.
  - ☐ read the manual which comes with the program.

- telephone a friend and ask questions about it.

- You are staying in a hotel and have a rental car. You would like to visit friends whose address/location you do not know. I would like them to:

  - draw me a map on paper.
  - tell me the directions.
  - write down the directions (without a map).
  - collect me from the hotel in their car.

- Apart from the price, what would most influence your decision to buy a particular textbook?

  - you have used a copy before.
  - a friend talking about it.
  - quickly reading parts of it.
  - the way it looks is appealing.

- A new movie has arrived in town. What would most influence your decision to go (or not go)?

  - I heard a radio review about it
  - I read a review about it.
  - I saw a preview of it.

- Do you prefer a lecturer or teacher who likes to use:

  - a textbook, handouts, readings
  - flow diagrams, charts, graphs.
  - field trips, labs, practical sessions.
  - discussion, guest speakers.

Appendix I: CSI Questionnaire

COGNITIVE STYLE INDEX

NAME.....	AGE.....
OCCUPATION.....	SEX.....

People differ in the way they think about problems. Below are 38 statements designed to identify your own approach. If you believe that a statement is *true* about you, answer **T**. If you believe that it is *false* about you, answer **F**. If you are *uncertain* whether it is true or false, answer **?**. This is not a test of your ability, and there are no right or wrong answers. Simply choose the one response which comes closest to your own opinion. Work quickly, giving your first reaction in each case, and make sure that you respond to every statement.
Indicate your answer by completely filling in the appropriate oval opposite the statement:

T True **?** Uncertain **F** **F**alse

		T	**?**	**F**
1.	In my experience, rational thought is the only realistic basis for making decisions.	0	0	0
2.	To solve a problem, I have to study each part of it in detail.	0	0	0
3.	I am most effective when my work involves a clear sequence of tasks to be performed.	0	0	0
4.	I have difficulty working with people who 'dive in at the deep end' without considering the finer aspects of the problem.	0	0	0
5.	I am careful to follow rules and regulations at work.	0	0	0

The questionnaire contains 38 questions; however 5 questions have been listed above for illustrative purposes, on specific instruction by the authors of the inventory. Please contact the authors (C.W.ALLINSON@LUBS.LEEDS.AC.UK) for a full copy of the CSI inventory.

PUBLISHED MATERIAL

1) The relationship between preferred modal learning style and patterns of use and completion of an online project management training programme.

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The Relationship between Preferred Modal Learning Style and Patterns of Use and Completion of an Online Project Management Training Programme

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Abstract

This paper reports the results of a pilot study, conducted to observe and evaluate the patterns of use and completion of a set of project management units and to identify any relationships between these factors and learning style. The aim of the study was to gather data on which to base a subsequent software development project, based around personalising the learning materials. The participants were adult professionals employed in public sector organisations in the UK and the study was based within a real business e-learning environment. Data regarding preferred learning style was collected via a questionnaire and usage, progress and completion rates were gathered from computer logging data, with user permission. To assess preferred learning style, the VARK inventory (Fleming and Mills, 1992) was used; this categorises learners according to modal preference for learning: Visual, Auditory, Read/write and Kinaesthetic. The results showed that learners with a preferred Visual mode showed the best record for completions and were characterised by frequent usage, but for relatively shorter study durations. In contrast, learners preferring the Auditory modality had the lowest proportion of completions, and also this group logged on less frequently but for longer study periods. Learners with a preferred Kinesthetic mode were characterised by the highest proportion of 'In-Process' learners (who were regularly using the system but not yet completed). The paper concludes with a proposal to build a personalisable learning environment incorporating specific modal features. A further study will then observe more closely the interaction between preferred modal learning style, mode of presentation and usage and performance.

Keywords: VARK, modal learning style, business e-learning, project management

1. Introduction

This paper reports the findings of a longitudinal study which took place over the course of 14 months. The study was set up to naturally observe learners' patterns of

use and completion of a set of units within a real business e-learning environment, rather than as a controlled study. The study aimed to identify relationships between learning style and the way the learning materials were used, in terms of study duration and times of the day as well as completion rates. The reason for conducting the study was to gather data on which to base a subsequent software development project, based around personalising the learning materials. A new system would provide varying levels of visual, written and auditory learning resources and modal preference was identified as a factor which could be important in producing an adaptive and personalised learning experience.

Various Learning Style inventories were considered, for example the Cognitive Style Inventory (Allinson & Hayes, 1996) and the Inventory of Learning Styles (Vermunt, 1992) were examined. One family of models which was identified as being appropriate to the aims of the research were those that consider sensory modality preferences. The models in this family may use different terms to describe the same or similar learning styles, but often describe three basic learning styles: auditory (through hearing the spoken word), kinesthetic (through interacting) and visual (through images, demonstrations and body language). In such models, the term *multi-modal* describes people who have more than one strong modal learning preference.

After much consideration, the VARK inventory (Fleming and Mills, 1992) was used; this categorises users according to modal preference for learning: Visual, Auditory, Read/write and Kinaesthetic. Fleming and Mills (1992) acknowledge that there is some overlap between preferences and define the four preferences as follows:-

Visual (V)

This preference includes the depiction of information in charts, graphs, flow charts, and includes all of the symbolic arrows, hierarchies and other devices that instructors use to represent what could have been presented in words. It does not include movies, videos or PowerPoint.

Auditory (A)

This perceptual mode describes a preference for information that is heard or spoken. Students preferring this modality report that they learn best from lectures, tutorials, tapes, speaking, group discussion, as well as email and web chat.

Read/write (R)

This preference emphasises text-based input and output - reading and writing in all its forms.

Kinesthetic (K)

This modality refers to the, 'perceptual preference related to the use of experience and practice (simulated or real)'. Although such an experience may invoke other modalities, the key is that the student is connected to reality, 'either through concrete personal experiences, examples, practice or simulation' [Fleming & Mills, 1992, pp. 140-141].

Each single preference can be mild, strong or very strong preference for that mode. Although there are only four different preferences on the VARK scale, there are 23 different permutations of preferences and it is possible to be multi-modal, with any combination of the preferences (e.g. AR, VRK or even all four VARK). Students who are multi-modal often need to process information in more than one mode in order for learning to occur.

2. Method

2.1 Participants

The participants comprised of adult professionals from a set of public sector organisations based in the UK. The majority of learners were mature professional workers, aged from 30 to 45 years, with 2 - 5 years project management experience.

The participants were informed that the data collected would not be personally identifiable and that it would be used for research purposes only. The responses to the questionnaire were recorded into the database using the learner's unique user id (primary key) rather than their names. The unique user ids were used consistently across the system to link and identify associated attributes across the system. The uniqueness of the user base is in the fact that they all come from public sector organisations.

2.2 System and learning environment

The study was based upon use of an online version of the standard project management method (PRINCE2[1]). The learning materials consisted of 12 online modules with a total of 115 lessons. Each lesson introduces and builds upon previous concepts via a slide which consists of text with visual support. The learning environment fosters active learning by promoting exploration, experimentation, construction, collaboration and reflection. This is done using for example: Notes (contextual information), Reference (references to the PRINCE2 Manual), a Quiz (comprehension / retention) and Tasks (application of concepts).

Learning was initiated after a brief face-to-face (classroom) induction session with introductions to the subject matter, product, e-learning and support facilities. These sessions were led by an accredited trainer. Although the learning content is structured for linear progression, the system is flexible and allows learners to choose their preferred approach. Subtle progress bars remind users of the extent of progress and module tests advise learners of the level of understanding and the expected levels for certification. Most participating authorities make provisions for specific time for the learning during working hours; however the users are free to access the learning platform from anywhere, at anytime as long as they are connected to the internet.

2.3 Materials

An online version of the VARK Learning Preferences Inventory was used. The VARK questionnaire is administered through a set of 16 multiple choice questions. The learning preference questionnaire was presented as part of the learning process on the second login to avoid any potential questionnaire fatigue (as baseline and motivation questionnaires had been administered prior to the start of learning). NB Further measures of motivation and qualitative follow-up data were also collected, however they are not considered in this paper (see Pereira, Jones & Taylor, submitted 2008).

3. Results

3.1 VARK data

The sample was made up of 31% of learners with a single modal preference and the remaining 69% of learners were multi-modal; this is close to the VARK norms of

[1] **PRINCE2** is a methodology in project management. It is a best practice in project management and a defacto standard in the public sector (UK). The methodology is being widely adopted by the private sector and abroad.

38% / 62%. Due to the sample being opportunistic (rather than representative and random), there were not equal numbers of learners in each of the VARK modal preferences. The percentages were: Visual 22%, Auditory 19%, Read/Write 29% and Kinaesthetic 30%.

3.2 System usage data

Measures of system usage included frequency, duration and time and day of login. Also learners progress was divided into four distinct groupings, which were clearly observed from the data.

'Non-Starters'

This group of users have 2 or less logins and have not logged-on during the past 5 months. The average time spent was 26 minutes, spread over an average of 5 days.

'Drop-Outs'

This category of users has more than 2 logins but have not logged-on during the past 5 months. This group have an average of nearly 11 logins spread over 35 days with nearly 6 hours of study.

'In-Process'

This is the largest of the groups and represents active users who are yet to complete their learning. Learners in this group have logged-on an average of 11 times, spread over 66 days with an average of 6 hours of study.

'Completed'

This category forms approximately 20% of the total users. The average usage is 32 logins spread over 7 months and approximately 18 hours of study.

One of the key features of learners in the Drop-Out group is that the learning happens mainly during working hours and very little during the late evenings / early morning or weekends. The majority (80%) of this time is spent during core office hours, the remaining 20% is spread across morning and evening twilight hours, with none during late evenings and weekends. In contrast, learners in the Completed group complete a fifth of their learning outside working hours (14% of their learning during weekends and about 7% during late evenings / early mornings). Learners in the Drop-Out group also have a lower frequency of usage but strangely a much higher average study period (of 44 minutes, compared with In-Process learners 29 minutes and Completed learners 42 minutes) and a longer time between logins.

3.3 Comparison of modal preference and system usage data

Table 1 shows the distribution of learners within each preferred modal style and their system usage status. As the learners are not equally distributed across each modal style category or each system usage grouping, the analysis looked at proportions to identify any similarities and differences in the data.

Table 1. The distribution of learners in each preferred modal style category and their system usage status.

Usage Status	*Modal Style*				
	V	A	R	K	Sub-totals
Non-Starters	0	2	2	1	5
Drop-Out	5	5	9	8	27
In-Process	30	28	41	46	145
Completed	17	10	19	18	64
Sub-totals	52	45	71	73	241

Individuals with a preferred Visual modality have a higher proportion of completions, higher scores and progress levels and a lower proportion had dropped out. Also, there are no learners with a Visual modal preference in the Non-Starter category. The average time spent is similar to the other modalities, however the usage frequency is higher indicating frequent but shorter study periods. The Auditory modality has the lowest proportion of completions despite relatively higher progress and scores. The usage frequency and time-spent data suggest less frequent logins and longer study periods (average 41 minutes) and the individuals with this modality preference also tend to do more of their learning during weekends (16%) and late evenings (8%) than any other modal preference. Learners with a Kinesthetic modal preference are characterised by the highest numbers in the In-Process usage status and their usage pattern suggests frequent but shorter study periods.

Although there are only a small number of Non-Starters, it is interesting to observe that none of these have a Visual modal preference. When the proportions of In-Process learners are compared, it is interesting to note that the largest proportion was from learners with a Kinesthetic modal preference. Of the Completed learners, the highest proportion came from those with a Visual modal preference and the lowest proportion came from those with an Auditory modal preference.

4. Discussion

The analysis of the modal preferences highlighted some interesting trends. The learners with Visual modal preference are characterised by frequent usage but with fairly short study durations and have the best record of completions (and lowest Drop-Outs). The learners with Auditory modal preference, in contrast have the worst record of completions (and the highest proportion of drop-outs and non-starters). They are characterised by less frequent logins but for relatively longer periods and also tend to do more of their learning during weekends and late evenings than any other modal preference. It may be then that Visual learners may perform better with a system which offers smaller modules or chunks of information, compared to Auditory learners, who may be able to sustain attention for longer. Read/Write modal preference learners have the highest proportion of Drop-Outs. Reasons for this are unknown, but it could be that learners with this modal preference would perform better using traditional paper-based materials, rather than the interactive multi-modal system used here. This would support previous research (Fleming, 2005).

The review on learning progress showed that there were no Non-starters amongst the learners with Visual modal preference. This could mean that the learning content is sufficiently visually engaging to ensure the learners return. Learners who had dropped out completed virtually all their learning during working hours, which is in contrast to Completed learners who complete 20% of their learning during late evenings and weekends. Drop-Outs also tend to have lower frequency of usage but with higher average study duration. Clearly, learners need to be encouraged to use the system out of office hours if they are to complete the course!

It is clear that there are some interesting interactions between modal preference, progress and usage times. However, further research is needed to identify whether progress is related to the modal preference or to the way that the system is used (e.g. out of office hours etc). Previous research has indicated that some learning environments are more conducive to some modal preferences than others. However, further study and observation is required to identify and isolate specific stimuli within this e-learning system that enable a learner with a particular modal preference to do better than others. For example, which specific elements of the instruction, presentation, content or channel are important for which type of learner.

The study was based on the natural use of an e-learning system by existing learners within a real business e-learning environment. This in contrast to much of the learning styles research which has taken place in traditional academic environments.

However, this has not been without logistical problems, e.g. learners did not start at the same time and came from different organisations, with different training ethos etc. As a result, it has produced data which is skewed and is not valid for statistical testing. Further research will ensure that some control is possible over the research environment (e.g. to control confounding factors) and yet maintain as near-natural usage as possible.

5. Conclusion and further work

This pilot study has identified some interesting similarities and differences relating to the progress and usage of the system for learners of different preferred modal styles. A proposal has now been produced to build an adaptive learning environment with a range of personalisation utilities. This will enable a further study to observe more closely the specific stimuli that lead to users with each modal learning style preference performing better than others and to track usage of these specific stimuli.

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LESS LEARNING, MORE OFTEN: THE IMPACT OF SPACING EFFECT IN AN ADULT E-LEARNING ENVIRONMENT

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ABSTRACT

Constant and continued up-grade of skills and qualifications is imperative in a knowledge society (Davies 1998, David & Foray 2003), however identifying and using effective (maximise retention / recall) and efficient (minimise time to learn) learning practices is often a challenge.

Spacing Effect is a robust phenomenon that suggests that the retention / recall of learning improves when presentations are spaced as opposed to massed (Toppino et al., 2002). Study-Phase-Retrieval (retrieval as a learning event), Encoding-Variability (multiple routes to retrieval) & Deficient Processing (in-adequate processing) are some of the theories proposed to explain the effect.

This paper presents the observations made of a real-life adult e-Learning environment for project management (PRINCE2^{TM}) based in the UK. The interplay between Inter Session Interval, Study Duration, Frequency of Usage and its impact on Time Spent & Time to Completion are explored using the concept of Spacing Effect.

The regression analysis of the key parameters showed a u-shaped relationship between spacing and total study time, largely consistent with the observations made by Verkoeijin, et al (2005) whilst reviewing the two-factor model of Spacing Effect proposed by Raaijmakers (2003).

While the lack of data and comparable studies on the effects of Spacing Effect in adult e-Learning / management training is acknowledged, this study does provide support to the notion of general applicability of Spacing Effect (Dempster, 1987) and highlights some of the gaps that remain in our understanding of the phenomenon.

1. INTRODUCTION

We live in a knowledge economy; a knowledge society continuously requires higher levels of skills and qualifications to fill the same jobs (Davies 1998, David & Foray 2003). Tony Blair proclaimed ‘education, education, education’ as the three most important endeavor’s of the British New Labour Government (1997). Gordon Brown, his successor, claims education and skills training is his 'passion' and a 'priority for the country' (BBC News, 3-Feb-2007). Lord Sandy Leitch's Review of skills report (2006) outlines UK's ambition to become a world leader in skills by 2020. Independent policy agencies such as the EU and OECD continue to assert the importance of education and life long learning (OECD 1996, 2006, EU 2000, 2007).

The educational needs of individuals are increasingly seen to be continuous throughout the working life, as labour markets demand knowledge and skills that require regular updates (Davies, 1998). Volery and Lord (2000) point to the capacity constraints and resource limitations that can be overcome through the implementation of e-Learning. DfES (2004 & 2005) attribute flexibility and pervasiveness as key drivers for e-Learning to have greater strategic social influence to support the learning requirements of the UK.

In this context the underlying project was initiated to explore avenues to scale up the project management capabilities across the local strategic partnership of authorities based in the south west of England. A web based e-Learning application (PRINCE2™ Passport from SPOCE) in PRINCE2™ Project management was identified as an efficient, scalable and (cost / time effective) practical solution. (The traditional model entails 5 days of intensive instructor-led classroom training typically costing around £1200 - £2000 per delegate.)

The learning application is currently hosted by Teignbridge district council (www.prince2online.org.uk) and is made available to the public authorities across the country. The project was part funded by ODPM's (Office of the Deputy Prime Minister, now called Department of Communities and Local Government) eInnovation scheme grant[#].

We have been observing this adult e-Learning environment over the past 3 years to understand the trends and patterns of usage and its implications on the learning process and outcome (Pereira, Taylor & Jones, 2008). This paper explores the interplay between Average Time between logins, Average study time, frequency of usage and its impact on Total Time spent & Time to Completion using the concept of Spacing Effect (Retention / Recall of repeated items improves when presentations are spaced).

Spacing Effect is a robust phenomenon that has been observed in explicit memory tasks such as free recall, recognition, cued-recall and frequency estimation (Mammarella, Avons & Russo, 2004) studied particularly in the foreign language learning and advertising fields. Although we have not located any data of this phenomenon in adult e-Learning, Dempster (1987) describes Spacing Effect as uncommonly reliable, remarkably robust and observed in virtually every standard experimental paradigm.

The remainder of this paper explores the theoretical accounts proposed to explain the phenomenon, the application / interventions of the concept, and a discussion of the observations from our data sample and finally some thoughts on potential implications for the industry.

The project has since then also won an award for 'Best in Category – e-Learning' from the ODPM. (2005)

PRINCE2™ is a methodology in project management. It is a best practice in project management and a de-facto standard in the UK. The industry provides for 2 levels of certifications in the method, foundation and practitioner.

2. THEORETICAL BACKGROUND

Many theories and cognitive accounts have been proposed relating to the effects of the Spacing Effect.

According to the Study-Phase-Retrieval theories (Braun & Rubin 1998; Green 1989), retrieval of the first presentation at the time of the second is essential, with the beneficial effect being greater for spaced than for massed repetitions. The second presentation serves as a cue for the involuntary retrieval of the first, if it is retrieved from long-term memory, then the person has had an opportunity to engage in retrieval practice. This essentially identifies the act of retrieval as a learning event.

Encoding-Variability theorists (Glenberg, 1979) hypothesize that spaced repetitions are more likely than massed repetitions to undergo variable encoding, which facilitates memory by increasing the number of effective retrieval routes. Spaced presentations allow for the formation of more cue-target associations, cues can be general (associations to the learning environment), contextual (associations to contingent items) and descriptive (associations to the stimulus). Increasing the time between the presentations creates greater opportunities for general, contextual and descriptive cues to change (Janiszewski, et al. 2003).

Deficient-Processing theories (Greene, 1989) propose that Spacing Effect results from inadequate processing of massed repetitions relative to spaced repetitions. People voluntarily pay less attention to the second presentation when it occurs shortly after the first as they recognise that the presentation of the two materials is not novel and can safely be ignored. Challis (1993) suggests that spaced presentations provides for more extensive semantic processing than massed presentations and as a consequence provides a basis for the Spacing Effect.

Raaijmakers (2003), proposed a two-factor model (also called SAM Model) combining two of the more influential theories, Encoding-variability and Study-Phase retrieval. The encoding variability component of this model suggests that contextual change, occurring between the first and second occurrence of a repeated item, is stored automatically with a repeated item's memory trace. These contextual elements provide cues to facilitate retrieval (multiple routes). This is expected to improve with spacing as the number of contextual cues increases with longer intervals. However, the study-phase retrieval component of the two-factor model dictates that the contextual changes are stored in the repeated item's memory trace only if the first occurrence of a repeated item is retrieved from long-term store at its second occurrence. As a result, Spacing Effect will only emerge for repeated items that have undergone successful study-phase retrieval.

Verkoeijin, Rikers & Schmidt, (2005) demonstrated the implementation of the two-factor model and report an inverted u-shaped relationship between interrepetition spacing and free-recall. They argue that, initially, the potentially negative effect of the second process (probability of successfully retrieving a repeated item's first presentation decreases as the interval increases) will be cancelled out by the first process (the amount of contextual change and the number of contextual elements encoded with a repeated item's memory trace upon study-phase retrieval increases with the length of the interval), giving rise to the Spacing Effect. However, at a certain spacing interval the balance must reverse and performance must decline with further inter-repetition spacing.

2.1 Practical Implications in using Spacing Effect

The Study-Phase theory argument suggests that the longer the interval between the presentations, the greater is the benefit of a (successful) retrieval but only up to a point that the retrieval begins to fail. The encoding processes at the subsequent / second presentation are ineffective at short intervals because the encoding context of the subsequent presentation is so similar to that of the first presentation but gradually increase with spacing.

Therefore the goal, it appears is to achieve as long an interval (ISI - Inter Session Interval) as possible without resulting in a retrieval failure, that is, achieving a difficult but a successful retrieval. This would translate to better and varied contextual memory traces and therefore more routes to retrieval.

2.2 Can it be quantified? How does it relate to Retention Interval?

Bahrick, et al (1993) report on their investigation showing that extended retrieval practice (foreign language vocabulary) yielded large retention benefits over a 5 year period. They highlight that these benefits were greatest when the inter session intervals were 2 months or longer.

Pashler, et al (2006) describe their ongoing study - 2000 subjects, ISI range of 5 minutes to 1 year, retention interval 1 year; and report early results that one month spacing produces 3 fold or greater

increase in retention as compared to a day or a week of spacing and suggest that the benefits of spacing grow larger as retention intervals are increased.

Rohrer & Pashler (2007) report an optimal Inter Session Interval (ISI) of 10 to 30% of the Retention Interval (RI) based on their numerous experiments (Swahili - English word pairs) with varying Retention Intervals. (ISI ranges of 5 minutes to 14 days, RI 10 days, 1 day ISI yielded the best recall; ISI range 5 minutes to 6 months, RI 6 months, and optimal ISI 1 month).

They also highlight 3 key observations - for any value of ISI, an increase in RI leads to a decline in recall; for any value of RI, an increase in ISI causes scores to first increase and then decline; as RI is increased, the optimal ISI increases as well.

2.3 Overlearning

Whilst the Spacing Effect attempts to demystify the effects of Inter Session Intervals, What about Study Duration? Is there optimal study duration for each session?

Overlearning can be described as a conscious strategy of continued practice. Rohrer, et al (2005) define overlearning as the immediate continuation of practice beyond the criterion of one perfect instance. However, if criteria are satisfied but further study is delayed until a subsequent session, then the post-criterion practice is not an instance of overlearning. Contrary to traditional beliefs, (Meta-Analysis by Driskel, Willis & Cooper 1992) that overlearning promotes retention; Pashler & Rohrer (2007) suggest that while overlearning increases performance for a short while, benefit diminishes sharply over time and (argue that the observations of previous studies are limited / characterised by their brief retention intervals, of about 1 week and often 1 hour or less) recommend distributed practice for effective long term retention. Similarly a study by Taylor, et al (2006) observed students complete 3 or 9 practice problems (mathematical) in one session, but this extra effort had no effect on test scores 4 weeks later. Rohrer, et al (2005) report a similar decline in the test benefits of overlearning (geography).

2.4 Commercial Applications

Supermemo is one of the practical applications of the Spacing Effect using an automated flashcard scheme. Knowledge is broken down into small chunks and scheduled for repetition in carefully determined intervals of time called optimal intervals. The optimal intervals are calculated on the basis of the contradictory criteria not too dis-similar to the two-factor model described above (as long an interval (ISI) as possible before resulting in a retrieval failure). The aim is to minimise the effects of forgetting and the overall time needed for learning. Wozniak (1990) claims theoretical basis to achieve up to 10-50 times faster learning than conventional methods and knowledge retention of 95% or more over a period of an average lifetime.

KnowlAgent is a contact centre e-learning solutions provider, they claim that their patented algorithms - RightTime^{TM} and RightContent^{TM} help identify individual agent performance gaps and skill deficiencies and addresses them by delivering high-impact, customised content directly to the desktop, at the most teachable moment, in the form of Learning Breaks, during forecasted and un-forecasted workflow downtimes. Not much information is however available on the theoretical basis of their application.

Tools such as Friday5s from Fort Hill Company (www.forthillcompany.com) and ActionPlan Mapper from ZengerFolkman (www.zengerfolkman.com) claim to provide post learning follow-through tools towards facilitating transfer / implementation of the learning at the workplace.

The hugely successful Dr Kawashima's Brain Training Software available on the Nintendo DS handheld game consoles insists on short ten minute fun mental exercises aimed at improving active cognitive performance (Pulman 2007).

3. METHOD

3.1 Participants

The project for PRINCE2™ e-Learning was launched in April 2005 after a brief pilot. The data was collected 28 months later when 238 users had used the learning system from across 18 distinct local authorities in the UK. The users had collectively clocked about 2562 hours (mean 11hrs) of learning spread across 4572 logins (mean 19).

The user base is reasonably homogeneous containing mature professionals in the age group of 28 - 45 with typically 2 - 5 years of project management experience.

About 42% of the learners (N=100) had completed their learning i.e., taken their exams and qualified / certified (PRINCE2™ Foundation).

3.2 Procedure

Four types of data were collected -

1. The quantitative data on learner's usage and progress has been collated from the underlying Learning Management System implemented as part of the learning platform.

2. **Pre-Use:** The learner's objectives and motivations for enrolling were collected using a questionnaire. The questionnaire was presented the very first time the users logged into the system, prior to access to the learning modules. The questionnaire covered a section each on Objectives / Motivations for Enrolling, Key Drivers, Learning Approach, Time Budgeted & Prior Experience with e-Learning.

3. **During-Use:**
The Cognitive Style Index (CSI) (Allinson & Hayes, 1996) was used to assess the learner's cognitive style preference on a dimension labelled as 'intuition-analysis' dimension.

Learning preference questionnaire was also presented as part of the learning process. The questionnaire uses VARK (Visual, Aural, Read / Write & Kinesthetic) Inventory developed by Fleming, N. D. (2005).

These questionnaires were presented on subsequent logins to avoid any potential questionnaire fatigue.

4. Qualitative data on learning environment, support systems were collected through interviews, discussions and interactions with learners, mentors and learning champions during the project.

The participants were assured of anonymity and confidentiality. The responses to the questionnaire were recorded into the database using the learner's unique user id (primary key) rather than their names. The unique user ids were used consistently across the system to link and identify associated attributes across the system.

Some of the above data is outside the scope of this paper (see Pereira, Taylor & Jones, 2008) and has been described in order to present an accurate and complete description of the learning environment.

3.3 Pedagogy Approach

3.3.1 Learning Design

The learning content is broken down into 12 modules (learning objects) with a total of 115 lessons (learning unit). A lesson is presented as a slide with suitable visual hooks to assist comprehension. Each lesson is further complemented by a Note (Contextual Information), Reference (references to the PRINCE2 Manual), Audio Narration (Linking up Concepts), Lesson Quiz (Comprehension / Retention), Task (Application of Concepts). Similarly additional support resources and assessment tests are available at the module level.

The core learning content (lessons) adopt an instructivist pedagogical style of learning to introduce and build on concepts. The learning environment complements this with notes, references, narration, tests, tasks, forum and support materials to foster cognitive & constructivist (active & social) learning by promoting exploration, experimentation, construction, collaboration and reflection.

Although the learning content is structured for linear progression the learners are allowed the flexibility to choose their preferred approach guided by the principles of andragogy (Knowles, 1990). Subtle progress bars remind users of the extent of progress; similarly module tests advise learners of the level of understanding vis-à-vis the module and the expected levels for certification.

The Learning Content and the Syllabus is formally accredited by the Governing Body, APM (Association of Project Management) Group who in turn are UKAS accredited.

3.3.2 Learning Path, Support & Environment

The learning program is initiated after a brief face-to-face (classroom) induction session with introductions to the subject matter, product, e-Learning and collaboration facilities. These sessions are led by an accredited trainer.

Asynchronous collaboration is facilitated through a dedicated forum on an associated portal.

Most participating organisations make provisions for specific time for the learning during working hours; however the users are free to access the learning platform from anywhere, at anytime as long as they are connected to the internet.

3.3.3 Learning Champion / Mentoring System

The initiative is spear-headed by a Learning Champion at each of the participating organisations. The Role of the Learning Champion is to entice buy-in from the management and encourage wider participation from across the organisation. (time commitments / motivation / face to face events)

The Learning Champion is further complemented by a mentoring (buddy) system whereby each learner is allocated a mentor from within the organisation. The Mentor's are typically individuals that have recently qualified in the method. The role of the Mentor is to allay fears, answer queries and provide support and encouragement during the learning process.

4. RESULTS & DISCUSSION

The Regression analysis of the PRINCE2^{TM} e-Learning database gives us the following regression equation (Appendix - A). The Usage Frequency represents successful logins, Study Period represents duration of study and the Time Between Logins represents the duration between logins. The sample data for this analysis has been limited to completed users (examined & certified, N = 100, 42% of the total database of 238) to ensure that the individual usage patterns are comparable.

Model	Coefficients B	Coefficients Std Error	t	Sig
Constant	-30627.1	8140.33	-3.76	.000
Usage Frequency	1463.86	146.20	10.01	.000
Mean Study Period	25.15	1.65	15.19	.000
Mean Time Between Logins (ISI)	-547.19	152.63	-3.58	.001

Dependent Variable: Time Spent
Table 1: Regression Equation

The following is an application of the above regression equation to the observed mean values of the samples predictor variables.

	Usage Frequency	Study Period (Minutes)	Inter Session Interval (Days)	Forecast Total Study Time (Hrs)
1	66	20	7	25
2	33.71	39	14.69	19
3	16	60	21	20
4	8	80	28	24

Table 2: Application of the Regression Equation

The case 2 above enumerates the mean values of the sample and gives the lowest outcome in the above comparison. In case 1 we observe the outcome of doubling the usage frequency and halving the Study Period and the Inter Session Interval. Similarly, case 3 & 4 observe the effects of 50% increase in Study Period and ISI and 50% decrease in Usage Frequency.

Relating the observed results to the theoretical account discussed above, contrary to the optimal ISI accounts of 10% - 30% of the Retention Interval reported by Rohrer & Pashler (2007) and Pashler, et al (2006), our results indicate an optimal ISI (14.69) of about 6% taking the mean time to completion as the Retention Interval (230 days). A reduction in the ISI to 7 days (3%) as reported by Bahrick, et al (1993) has a detrimental effect on the forecast total study times.

The data demonstrates a strong Spacing Effect with a u-shaped function. The overall trend is similar to an inverted u-shaped relationship reported by Verkoeijin, et al (2005) when reviewing the two-factor model (Raaijmakers, 2003). Whilst, the shape of the relationship is consistent, it has to be noted that the outcome parameters are not the same. Most of the studies observed the outcome as the extent of retention / recall after a given Retention Interval, whereas this study measures outcome as Total Study Period (forecast). However, as the sample is characterised by completed users, we could argue that completion in itself represents successful retention / recall and therefore Total Study Time is a valid metric of relative success with the objective being to minimise it as prescribed and facilitated by Supermemo's (Wozniak, 1990) implementation of benefiting from the forgetting curve.

5. CONCLUSION

5.1 Limitations

Many of the observations on Spacing Effect are on learning foreign language words, word-pairs and often with trivial retention intervals (Rohrer, D. & Taylor, K. 2006) with young students for subjects with an objective of achieving retention / recall, what might be described as lower level learning outcomes, i.e. Knowledge & Comprehension (Blooms Taxonomy, 1956). In contrast, our sample is characterised by adult management professionals employed in the public sector (UK), engaging in work place learning to acquire a new skill with the objective of using it in their workplace. (potential Application and some degree of Analysis, Synthesis & Evaluation). However, the sample in this study

has been limited to individuals achieving foundation level of the method. The stated criteria of the foundation level is to assess lower level learning (Knowledge & Comprehension) whilst the practitioner level assesses the individuals ability to apply, evaluate and analyse the use of the method in a given scenario.

5.2 Implications

Whilst there are significant differences between the samples of the previous studies and the current sample, constituting solely of adult professionals (Andragogy, Knowles 1990), the results are clearly consistent with the inverted u-shaped relationship reported by Verkoeijin, et al (2005), albeit at different levels.

The above findings raise some important questions on the traditional model with Intensive and rigorous massed learning events. The majority (over 80%) of training in the subject matter (PRINCE2^{TM} project management) is instructor lead intensive 5 day events. While their brevity and their intensive instruction / guidance just before the exam makes them popular, they prevent sufficient spacing (Rohrer, D. & Pashler, H. 2007) and run the risk of producing deceptively high initial levels of learning followed by rapid forgetting.

Although stand-alone Follow through tools, have evolved in an effort to fill this gap, they still remain a small niche. More widely used enterprise applications such as Virtual Learning Environments (VLEs), Learning Management Systems (LMS) & Knowledge / Talent / Performance Management Systems, etc might be better positioned and have a better opportunity to incorporate the benefits of the Spacing Effect in scheduling and sequencing study sessions in ways that optimise long term retention. (Refresher courses, summary of previous learning, adaptive feedback)

While repetition and distributed / spaced practice are clearly the drivers to the Spacing Effect (Cepeda, N., et al 2006), questions remain on the nature and the construct of distributed / spaced practice.

- Is there any merit to inter-sensory (Visual, Aural, Read / Write, Kinesthetic) repetitions?
- Will they contribute to a better quality memory trace / cue?
- Are they affected by individual cognitive style / preferences?
- Do these principles apply to higher order learning?

5.3 Summary

In summary, smaller more frequent learning instances spread over time appear to be more effective than the traditional single hit massed learning. The theoretical accounts (Glenberg, 1979; Braun & Rubin 1998; Green 1989; Raaijmakers 2003) of Spacing Effect attribute extra cognitive effort by varied memory traces and encoding strategies for the benefits of spaced learning. The case against overlearning (Rohrer D. et al 2005; Rohrer & Taylor 2006; Rohrer & Pashler 2007) clearly has merit.

While this study does provide some support to the notion of general applicability (Dempster, 1987) of the Spacing Effect, significant gaps remain in our understanding of the phenomenon in the adult e-Learning environment and warrants further research.

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APPENDIX

A. REGRESSION ANALYSIS

Variables Entered / Removed (b)

Model	Variables Entered	Variables Removed	Method
1	Avg. Time Between Logins, Avg. Study Time, Usage Frequency(a)	.	Enter

a All requested variables entered.
b Dependent Variable: Time Spent

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.876(a)	.768	.761	26560.023

a Predictors: (Constant), Avg. Time Between Logins, Avg. Study Time, Usage Frequency

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	224056203774.195	3	74685401258.065	105.871	.000(a)
	Residual	677217451333.246	96	705434845.138		
	Total	291777948907.440	99			

a Predictors: (Constant), Avg. Time Between Logins, Avg. Study Time, Usage Frequency
b Dependent Variable: Time Spent

Coefficients (a)

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-30627.131	8140.332		-3.762	.000
	Usage Frequency	1463.861	146.201	.566	10.013	.000
	Avg. Study Time	25.155	1.656	.780	15.190	.000
	Avg. Time Between Logins	-547.192	152.637	-.200	-3.585	.001

a Dependent Variable: Time Spent