

**New Workplace Media in Practice: An exploration of the Relationship
between Learner Styles and Media Choice in an Online e-Learning
system within a Corporate Environment**

Case Study – Legal Firm, Ireland

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Abstract

The effectiveness of e-learning within a Corporate Environment must be critically evaluated to ensure optimum, cost effective results. Lifelong Learning, smarter training requirements of a recessionary business environment and efforts of employers to combat competition are leading to increased workplace training. The continual emergence of new media methods of presenting instruction brings challenges to developers of workplace e-learning. What is the correct media choice for a specific audience? With limited resources firms cannot afford to supply all media types and supplying media that does not suit learner needs, may reduce e-learning effectiveness. This case study looked at patterns of choice in media selection, taking learners' styles into account. Whereas there was no evidence in this study of correlation between learner style and media choice, the findings point to a clear preference of all learners for Interactive media, a lack of preference for PDF manuals and the avoidance of video by some learner types. The overall findings show that it is important to be aware of an audiences' pattern of media choices so that appropriate adjustments to the e-learning can be applied where necessary.

Keywords: workplace; learner style; media; e-learning; corporate environment

Introduction

This study explores the relationship between learner style and learner choice of media within e-learning. It is conducted in a corporate environment. Many media and media combinations are available, with new media continuing to be developed. What media to include in e-learning is an important consideration. Choosing media that suits your audience may mean more effective learning (Vincent & Ross, 2001). This study demonstrates that patterns of learner choice, based on learner style, can be displayed by using simple, efficient and cost effective methods that could be applied to a Learning Management System (LMS) in many corporate and academic environments. Decisions informed by this pattern could advise and support e-learning development.

The issue of Lifelong Learning is a growing education area, possibly due to increased

awareness by educators and learners of a continuous need to acquire and update new knowledge, skills and competencies in an environment of constant change (Taskforce on Lifelong Learning, 2002). With the scarcer resources of recessionary times upskilling and maintaining competencies has become even more important for many people, including those in the workplace. One 2011 UK study shows how increased market competition during a recession, may trigger employers to increase training.

Employers were:

induced by the recession to find ways of training smarter [...] and enhancing the role of e-learning (Centre for Learning and Life Chances, 2011, p.5).

A 2012 study found training programmes increasing in capacity in European companies (Towers Watson, 2012).

Many studies examine correlations between cognitive/learning style and other aspects of learner differences and the learners' media preference (Akbulut & Cardak, 2012).

There is much research into adaptive software that automates the delivery of lessons to suit the learner characteristics – such as learner style, cognitive style, prior learning (Brusilovsky, 1996; Sadat & Ghorbani, 2004). This study did not use automated adaptivity. An adaptive system modifies itself or another system to deal with different situations and various circumstances. (Eltigani & Mustafa, 2011).

An alternative technique is proposed here: to determine a learner style and use it to advise the creation of suitable media. Literature reviewed for this study considers adaptivity research, and studies including adaptability (where the user has control of the e-learning adjustment) (Kay, 2001; Oppermann, Rashev, & Kinshuk, 1997).

Chen & Sun identified their learners' style as verbalizers and visualisers, (a similar concept is used in this study). Finding, that the best learning performance for verbalizers came from video-based multimedia and that for visualisers media containing

video/animation surpassed “static multimedia materials containing text and image” (Chen & Sun, 2012, p.1273)

Kollöffel used verbaliser/visualiser as an example of cognitive style with fourth-eight participants, finding “learning with a preferred format does not enhance learning results” (Kollöffel, 2012, p. 697)

In 2013 Ocepek uses a combination including Kolb's classification and the Visual, Auditory, Kinesthetic (VAK) classification as a method of providing more precision in correlating students' learning style with multimedia preferences. The study of 272 students concluded that while there is a “need to combine learning styles model” the combination presented problems since students needed to completed four different questionnaires to determine a style (Ocepek, 2013, p.343).

Akbulut and Cardak (2012) undertook a content analysis of literature dealing with the design of adaptive educational media that included learners' styles as an influencing element. They looked at seventy studies published from 2000 to 2011. Indexes or scales for learning style identification were used in 52.9% of the 70 studies. Learning styles were used as the adaptivity technique in 81.4% of the studies, with Felder Silverman Learning Style Dimensions used in 50% of cases- the most popular instrument. Questionnaires were administered 52.2% of the time with data tracking used in 45.7% of the studies. This case study uses Felder Silverman Indexes, Questionnaires and data tracking (analytics). The review of a decade of studies deemed learning style based adaptivity to be successful. Students had a more positive attitude to e-learning where it adjusted to suit their learning style (Akbulut & Cardak, 2012).

Background

The corporate environment of a legal firm is chosen for this study. In undertaking research for clients with a need for e-learning, the author discovered that legal firms (Cork), have little or no ongoing staff training for routine procedures, use of office equipment and practice-specific software (Murphy, 2014). In consultation with the firms' management, an agreed curriculum was identified where gaps in knowledge and skills exist that an e-learning programme could assist. This research is based within that context and explores, using the e-learning and Learning Management System (LMS), why learners choose particular media types- for instance, watching videos over reading PDFs.

When recessionary environments limit resources, research shows that companies, including legal firms, reduce staff development expenditure. In a Law Review symposium issue "The Economic Downturn and the Legal Profession" Eli Wald (2010) finds that, for the USA, the "economic meltdown on the legal profession has been quite devastating: [with] unprecedented layoffs" (p.101). The Final Report on Human Resources in the Recession showed little evidence "of firms introducing greater training and up-skilling programmes for employees" (Labour Relations Commission, 2011, p.8). It is therefore important for corporates, especially legal companies, to find focused and staged training methods. E- Learning is one answer to a focused approach, especially if that e-learning can be targeted to particular learner styles and use of media, thereby encouraging effective learning to take place- since many studies "agree that learning styles exist and acknowledge the significant effect that learning styles have on the learning process" (Vincent & Ross, 2001, p.2).

The theory of learning styles is employed in education to examine learner traits and classify learner types. The theory is extended to advise instructional design and

development in the creation of learning materials to suit the learning style of all learners. Where a learner has a strong preference for a particular way of learning, their assimilation of data is made more difficult when material is not delivered in their preferred way (Gregoric, 1985). The presence of a predominant learner style has Instructional Design implications for material creation, decisions on media and methods of instruction. Taking account of learner styles during e-learning design and development “can maximise learning potential” (JISC, 2004, p.35).

Research Method

This research study uses a mixed-methods (use and mix both qualitative and quantitative approach) using quantitative Instruments to conduct research in a qualitative case study of a single firm providing in depth analysis of a small number of units (Patton, 2002; Tashakkori & Teddlie, 2003).

A case study approach addresses the research with a focus “on a specific instance or situation” (Bell 1993, p.8) and can concentrate on characteristics of an individual unit (Cohen & Manion, 1989). The case study research method is relevant regarding education (Gulsecen & Kubat, 2006) and allows a comprehensive analysis of a single situation (Yin, 2003). While the qualitative research allows us to take an in-depth study of the case location, the quantitative instruments allow a quantification of media usage.

The study population uses the entire twenty-four employees of the legal firm. There were twenty-one respondents from that group. The cohort of participants is small, therefore findings of this study may not be generalised to other populations. A snapshot case study view of the firm is provided, rather than any generalisation to industry or legal firms as a whole. Given that we have a “representative sample from a known population” (legal firm) generalisation to that population can be done according to “the usual rules of statistical inference.” Notwithstanding the difficulty in replicating any study, the ease of application of the research instruments and the success of the provision and analysis of the LMS analytics makes it feasible to carry out a further study with an “other type of participant” or in another “setting” as a “direct demonstration” (Robson, 2002, p.107).

The Research Methods employed in this Case Study are:

1. Questionnaire, collecting learner demographics
2. Felder Silverman Index of Learning Styles (ILS)
3. Moodle Data Analytics

The rationale of this study is based on the premise that learners have a predominant learning style and that this style may influence their decision to choose one media over another within a course of e-learning study.

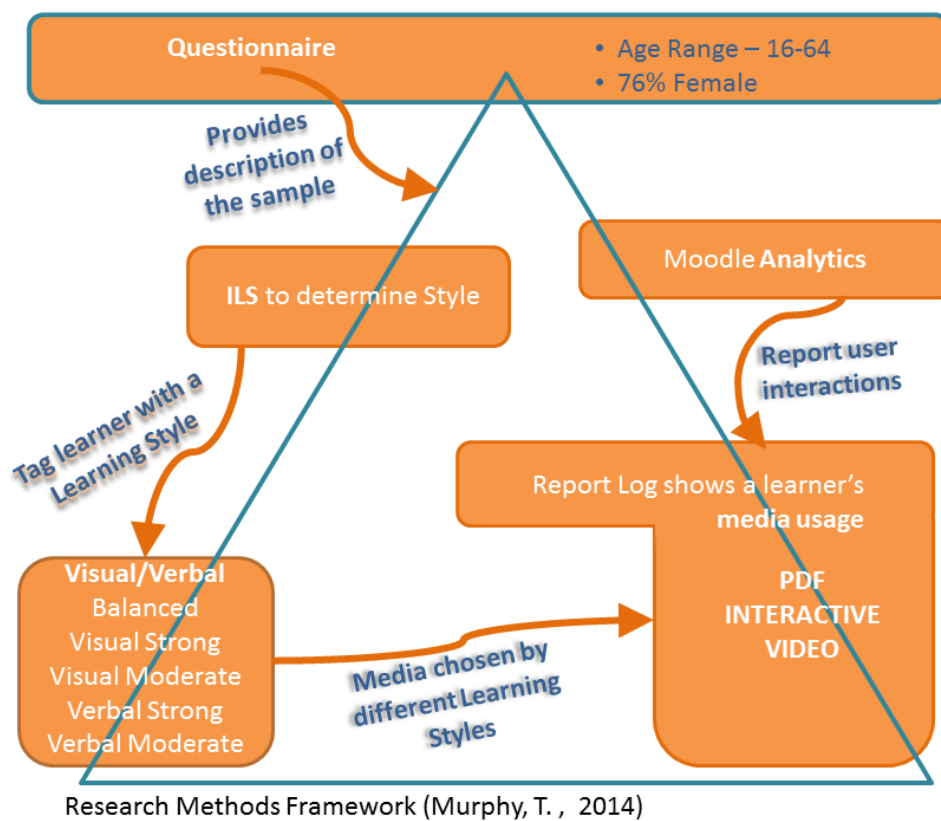


Figure 1. Research Methods Framework

Regarding positionality, the researcher is known to respondents as an e-learning developer but not as a researcher. Conducting the questionnaire and ILS survey through online methods, where the researcher is not present during completion of the research instruments, attempts to reduce the Pygmalion Effect- a respondents' reaction to perceived expectations of the researcher (Lewis-Beck, Bryman, & Liao, 2004).

To check the learner-style/media- preference relationship two variables are declared.

- (1) Media choice
- (2) Learners' style

The media choice is declared by providing three different media types for each lesson in the e-learning course (Interactive, Video and PDF).

Each medium has a predominant delivery style, although containing a mix of media types. This predominant delivery defines an assigned media *Label*. The Labels applied to the media types are: Interactive, Video and PDF. The interactive lesson requires continual learner intervention in order to proceed. The Video walk-through provides the same content as the Interactive Lesson but all the choices are made for the learner allowing passive viewing of the content. The PDF emulates traditional paper-based instruction manuals and contains step-by-step instruction texts along with explanatory illustrations. These media are defined in Appendix 1.

Moodle analytics provides data through reports, logs and data stored in the background SQL database that can be used to analyse a learners' behaviour within a virtual learning environment (Romero, Ventura, & Garcia, 2008). Analytics has been used for many years to aid business transformation (Kiron, Shockley, Kruschwitz, Finch, & Haydock, 2011) and also as academic or learning analytics (Long & Siemens, 2011). Moodle Data analytics contains details of SCORM elements and of learner activity and returns logs of all LMS activities that students perform (Rice, 2006). Moodle raw data in MySQL tables can be accessed using MyPHP-Admin software, but there is enough data in the Moodle course reporting module for the purposes of this case study. The Moodle menu choice: *Course Administration, Reports, Logs* creates a report on all or a selected user(s) showing interactions with course elements. This report identifies the user and their lesson choices. E-learning Lessons are titled as in Table 1:

Table 1. Moodle Media Naming Conventions

Media	Naming Convention	Example Name
Interactive choice	by just a lesson name	Alarms
Video Walk-Through media	the lesson name with the additional suffix <i>Video</i> appended	Alarms Video
The Folder containing the PDF media	Folder name and suffix <i>Manuals</i>	<i>PDF Manuals</i>

This consistent naming convention allows the learner choice to be identified in the Moodle logs. For example, Figure 2 shows part of a Moodle activity log. Media chosen by learners are clearly identifiable in the *Event Context* field.

A. SCORM package:Using Cort Software Video –Video media
B. SCORM Package: Alarms- Interactive media
C. Folder: PDF Manuals to... PDF media

Time	User full name	Affected user	Event context	Component	Event name	Description	Origin
3 Aug. 2:33			SCORM package: Using Cort Software Video	SCORM package	Course module viewed	The user with id '4' viewed the 'scorm' activity with the course module id '52'.	web
3 Aug. 2:33			Course: Staff Learning	System	Course viewed	The user with id '4' viewed the course with id '2'.	web
3 Aug. 2:29			Folder: PDF Manuals to View and Download	SCORM package	Sco launched	The user with id '4' launched the sco with id '24' for the scorm with the course module id '12'.	web
3 Aug. 2:29			SCORM package: Attach a Scan	SCORM package	Course module viewed	The user with id '4' viewed the 'scorm' activity with the course module id '12'.	web
3 Aug. 2:29			Course: Staff Learning	System	Course viewed	The user with id '4' viewed the course with id '2'.	web
3 Aug. 2:20			SCORM package: Alarms	SCORM package	Sco launched	The user with id '4' launched the sco with id '30' for the scorm with the course module id '15'.	web
3			SCORM	SCORM	Course	The user with id '4' viewed	web

Indicates VIDEO used (A)
Indicates PDF used (B)
Indicates INTERACTIVE used (C)

Figure 2. Moodle report- User Interactions in the *Event context* field

From Moodle log reports it is possible to use the “Event context” field to identify the media element that the user has interacted with. This report can be exported to a spreadsheet for analysis and charting (Romero et al. 2008, P. 375).

The research instrument reliability can be assessed, in that, by following the naming conventions and exporting the Event Context field in, we ensure that if this experiment is repeated, we would be able to consistently infer media use in the same manner. Reliability meaning: “the consistency with which we measure” (Robson, 2002, p.101).

To ensure validity of this instrument care has been taken in the identification and labelling of each media and the placement of lessons within the LMS menu structure. Validity being: are “findings really what they appear to be about”? The e-learning menu lists media types available. The *Types of Lessons Available* introduction video identifies and indicates availability of alternative media. Each course section is divided into Interactive, Video, and PDF. These measures allow the learner to choose media that suits them and the findings are based on those choices. (Robson, 2002, p.93).

The e-learning is available before and after the study as a staff induction and on-going learning resource. This permanency reduces the Hawthorne effect(defined as: where learners may alter their behaviour due to environmental changes, such as implementation of the e-learning system, rather than alterations due to the elements themselves, such as the available media choices) (Lewis-Beck, Bryman, & Liao, 2004).

The learners are aware that a study is being conducted but they do not know the primary focus of the study. The media choice behaviour of learners being studied is unlikely to be altered by their awareness of the study, because they are using the e-learning system on an ad-hoc basis for their own learning requirements and there are no learner observable measurements of learner actions taking place.

The learners' style variable needs to be determined for the media relationship to be examined. There are several popular Learning Style Models, such as the LSI (Kolb, 1994) and LSQ (Honey & Mumford, 1992) the Dunn & Dunn model (1974) and Felder and Silverman (1988). These four are examples of Learning Style Models (LSM) drawn from an extensive list of over 50 different available LSM. In the critical review "Learning styles and pedagogy in post-16 learning" the list of LSM is organised into Families of learning styles (Learning and Skills Research Centre, 2004).

Learning styles and preferences are largely constitutionally based including the four modalities: VAKT ¹ .	Learning styles reflect deep-seated features of the cognitive structure , including 'patterns of ability'.	Learning styles are one component of a relatively stable personality type .	Learning styles are flexibly stable learning preferences .	Move on from learning styles to learning approaches, strategies, orientations and conceptions of learning .
Dunn and Dunn² Gregorc Bartlett Betts Gordon Marks Paivio Richardson Sheehan Torrance	Riding Broverman Cooper Gardner <i>et al.</i> Guilford Holzman and Klein Hudson Hunt Kagan Kogan Messick Pettigrew Witkin	Apter Jackson Myers-Briggs Epstein and Meier Harrison-Branson Miller	Alinson and Hayes Herrmann Honey and Mumford Kolb Felder and Silverman Hermanussen, Wierstra, de Jong and Thijssen Kaufmann Kirtan McCarthy	Entwistle Sternberg Vermunt Biggs Conti and Kolody Grasha-Riechmann Hill Marton and Saljo McKenney and Keen Pask Pintrich, Smith, Garcia and McEachie Schmeck Weinstein, Zimmerman and Palmer Whetton and Cameron

Figure 3. - Learning Styles Families (Learning and Skills Research Centre, 2004)

The Felder-Silverman Learning Style Model (FSLSM) suggested by Felder and Silverman (1988) is more comprehensive than other learning style models of the same family. It provides a detailed view of a learners' style where the style preferences are distributed over four dimensions: active/reflective; sensing/intuitive; visual/verbal; sequential/global. After comparing several learning style models, Kuljis and Liu (2005) rated FSLSM as the "most appropriate" model "in respect to e-learning design and development" (Kuljis & Liu, 2005, cited in Graf & Kinshuk, 2006, p.2).

The FSLSM (Felder & Silverman, 1988) has been used in many studies to determine learner characteristics and is also often utilised as a learner behaviour analysis tool to generate adaptive e-learning. For example, the model is used for

adaptive learning purposes and LMS systems automated delivery of learning depending on the determined style (Graf, 2007; Hong, 2004; Howard, 1996; Mohamad, 2013; Peña, 2005; Tzu-Chi, 2013; Zywno, 2003). Learners' learning style preferences were studied using FSLSM during a 2006 e-learning course (Graf & Kinshuk, 2006).

Felder and Soloman (1997) established an Index of Learning Styles (ILS) for their model. Felder & Spurlin (2005) reviewed the results of studies using ILS collected data and confirmed the reliability and validity of the ILS. (Felder & Spurlin, 2005). The ILS has been used by many educational researchers. For example, a study of learning styles in a management class De Vita (2001) it was used to create a learner profile.

The ILS is a 44-item questionnaire using four polar-scales related to learning style preferences. Each scale contains eleven items. The ILS rates a learning style over the four dimensions of active/reflective; sensing/intuitive; visual/verbal; sequential/global.

Summary of reasons for using FSLM and the ILS in this study

- (1) FLSM previously used by many researchers
- (2) Provides a comprehensive style assessment that suits e-learning research
- (3) Validity and reliability proven
- (4) Questionnaire available online
- (5) Questionnaire on the site is easy for learners to use
- (6) Questionnaire on the site is quick to complete
- (7) FSMLSM authors provide the ILS online questionnaire with completed guidelines
- (8) Results are correlated on the site and available to the researcher immediately
- (9) ILS is free to use and constitutes a cost efficient data collection method

The FSLM third domain determines what the learner preference is for receiving information. Their learning style preferences will range from *visual* (Images, diagrams, videos) through to *verbal* (text, vocalised instructions) (Felder & Spurlin, 2005).

Using results from the ILS there are several possible routes that may lead to relating the learners' media preference to their learning style. Data from any of the four dimensions could be employed to put a defining label on the learners' style.

Sensing/Intuitive dimension measures *perception* of information. Active/Reflective concerns the way a learner *processes* information. Sequential/Global relates to *understanding* information. The third ILS dimension – Visual/Verbal deals with “Receiving Information” and is the primary concern of this case study, since media selection is the learners' choice *of a way to receive information*. The e-learning provides this choice (Karacapilidis, Raisinghani, & Eugenia, 2012).

A 2007 study (Graf & Kinshuk) specifically excluded data relating to this visual/verbal dimension. It used Felder Silverman ILS to study effects of learner style providing Adaptivity in Moodle. The dimension was excluded since it:

would ask for different presentation modes, for example, including text, audio-files, video-file.

The complication of different media was avoided in their study but *different media* is exactly the requirement in our study and a reason to use the learners' placement on the visual/verbal dimension in our correlation with their media choice (Graf & Kinshuk, 2007, p. 257)

Visual (VIS) learners are most likely to remember what they see: photographs, charts, diagrams, illustrations, animations, flow-charts, experiments, videos, etc. The Verbal learner (VRB) remembers what is heard, read or said: audio, voice-over, sound effects, text, captions.

Using the title *Entry Channel* to describe the information-receipt feature of this dimension we can list the media characteristics required to be supplied during training in order to match with a learners' style (Franzoni & Assar, 2007).

Entry Channel	Visual	Verbal
Specifications		
Description	Highly visual elements	Oral and text elements
Appropriate pedagogical method	Rather work with visual representations when receiving information and remember what they see	Rather receive information spoken or verbally and remember what they read or hear
Characteristics of the media to be used	Visual representations and diagrams	Text and sounds
Associated Teaching Strategies	Games and simulations Presentation	Discussion panel Brainstorming Question and answer method

Figure 4. Using Learning Styles to enhance e-Learning (Franzoni & Assar, 2007, p.21)

Where a learner tends toward the “Visual”, left of the scale, “a designer would create media with more “Visual representations and diagrams”. Where a learner tends toward the right of the scale into being “Verbal” a designer would create media that had more “Text and sounds”.

Development

Learner styles were determined using Felder-Silverman Learning-Style Model ILS and the alternative media choices provided by constructing a custom-built corporate e-learning environment. To test the media-to-style relationship the author purpose-built an e-learning course, for a Cork City legal firm. Instruction on Office Procedures and Software Use is delivered by the e-learning. In order to determine whether learners display a preference for a media type the course is purpose-built to provide the same instruction via multiple media types. The course menu makes it obvious that it is up to the learner to select the different media they wish to view in any lesson (Appendix 8). An introduction video lists each media and gives an overview on its use. The introduction does not make any references to situations in which to use any media or mention anything that might influence the learner to choose one media over another.

The environment includes multiple media choices for each lesson allowing the learner to select from: Interactive simulation lesson, Video walk-through lesson or PDF instructional manual. The e-learning is designed to show whether learners, possibly by virtue of their predominant learning style, tend to choose a particular media type.

The Interactive simulation requires the learner to click hotspots to move on to the next part of the lesson. The Video walk-through has the same content as the Interactive but no interaction is required. All the hotspot clicking is absent and the process is just like passively watching a video. Both contain a menu system to allow non-linear study. The PDF is a training manual step-by-step instruction document.

To emphasise to staff that this is a new learning initiative a new domain name is purchased – fitzgeraldsolicitors.ie and a subdomain called “learn” is created, giving a web address of <http://learn.fitzgeraldsolicitors.ie>. A new hosting scheme capable of facilitating the PHP and SQL requirements of Moodle version 2.7 is contracted to store

the new material and Moodle is installed as a web-application. The Essential Theme is applied providing a responsive platform to react with and deliver an optimised format to all connected devices including mobile. The theme is configured and modified to present a coherent corporate identity matching the company current logo and colour scheme. Photographs of the office interior, office devices, and building exterior are used within the Moodle interface and the lesson media to further reinforce the connection between the learning and the company identity. Links to legal third-party learning resources are provided on the Moodle entry page to emphasise the web domains' educational nature.

Articulate Storyline and Adobe Captivate are used to create a multimedia mix for each Interactive lesson. The media mix consists of: video, scanned documents, photographs, caption text, title text, male and female audio voice over, female cartoon character. Each lesson contains a formative review quiz that questions key learning outcomes.

The Video is created by capturing the activity of a learner proceeding through the Interactive lessons. The final published video lesson shows all the instructional steps and each interaction.

The source files of the Interactive lesson in Storyline and Captivate authoring environments are used to export content to a "PDF". This data is opened in Microsoft Word and instruction manuals created by using the export, added images from source videos and photographs, and text from the voice-over scripts.

The supplied Media types (Interactive, Video, PDF) are named after their predominant mode of delivery but each contains a mixture of media. During development of the e-learning media content the author created and followed a Conceptual Framework (Murphy, T., 2014). The framework is based on an adaptation of existing development

matrix (Cisco Systems, 2008; Franzoni & Assar, 2007) and on interpretation of associated theory regarding Cognitive Load Theory Effects, multimedia and modality principles (Artino, 2008; Chan & Black, 2006; Ginns, 2005; Mayer, 2001; Mayer & Moreno, 2003). Column three in the Conceptual Framework (Appendix 10) is the interpretation, presenting a guideline to aid content creation in this study. The framework was used to ensure that each media had equal instructional integrity and pedagogical value. Where each media type is perceived as *equal*, one would not be considered by users to be *better*, thereby possibly skewing a preference by learners for that media.

By adhering to the guidelines in the third column of the Conceptual Framework (Appendix 10) the instructional media are designed to conform to best practice. This optimised the teaching ability of the media ensuring the learner could effectively assimilate the content regardless of which media type was chosen thereby removing a difference in quality as a reason for learner choice. The ADDIE (Analyze, Design, Develop, Implement, Evaluate) framework was followed during e-learning creation (Appendix 11) and in addition an Agile learning design approach was employed using constant feedback from client and users through prototype, pilot and deployment phases (Peterson, 2003) .

Study Implementation

The group available for this study consists of the entire twenty-four staff of the legal firm. All staff were notified, by email, of their new Moodle accounts and included in the “Staff” cohort. The Staff Cohort was enrolled in the Staff e-learning course, giving access to all staff.

The demographic questionnaire (Appendix 2) was created online (Google Form) and sent by email from Google Drive to all staff. Responses are automatically collated into a Google Spreadsheet. The spreadsheet is downloaded in Microsoft Excel format for analysis. Learners’ *Name* was a required field enabling matching the ILS return with user activity in Moodle to the same learner. Anonymity was guaranteed in advance (Appendix 4).

The FLSM Index of Learning Styles (ILS) URL was emailed to all staff with instructions on usage and how to return the result to the author (Appendix 3). A staff member is appointed to provide technical support to respondents during results collection phase. Scores on each dimension are added to the appropriate learners’ record in the Microsoft Excel analysis file created from the demographic questionnaire data. Those who returned the questionnaire but not the ILS result, or *vice versa*, were prompted to complete the missing items. Sampling was governed by those who returned the questionnaire and ILS data. They were then included in the study *if they also used the e-learning*.

Google Analytics is available, but not used in this case study, for the data collected through Google Drive (Appendix 5). The results from responses to the demographic questions and results from the scoring on the ILS dimension scales are combined in Excel for each user record (Appendix 6).

The position of the learner on the ILS Visual/Verbal dimension data result is mapped to a text label indicating the learners' style using a "Vlookup" function that calls data from a mapping table (Appendix 7). The lookup table content is derived from the instructions contained in the results page of the ILS (Appendix 7)

According to their position on the Visual/Verbal dimension scale learners are tagged with an identifying text label (Table 2):

Table 2. Tag assigned indicating learning style (Appendix 7)

Tag	Abbreviation
BALANCED	BAL
VISUAL MODERATE	VIS MOD
VISUAL STRONG	VIS STR
VERBAL MODERATE	VRB MOD
VERBAL STRONG	VRB STRG

This research examines the relationship between learning styles and learner media choice. It provides empirical assessment of how the groups of Visual/Verbal learners interacted with an e-learning system that provided content choice in several different media. The placement of the media in the e-learning system presents a learner choice in media selection and allows an objective experiment where researcher bias or influence in the media choices was minimised. The e-learning system is a deployment of learning that is required for staff learning in this legal office. All evidence of media choices is collected through Moodle data analytics. The process of the data collection during e-learning use is transparent to the learner.

The data used from Moodle logs to detect the learners' media choices was generated on 22nd August 2014 using the command: Site Administration ->Reports->Logs.

Report Filters used were: *All days, All activities, All actions, All educational levels*. This generated one log output per each learner. There were a total of twenty-one

learners selected (matching 21 completed Demographic Questionnaires and ILS Surveys). The twenty-one CSV files were downloaded and combined in Excel. The dates of learner activity records retrieved were from 23 July 2014, 17:12 to 22 August 2014, 10:31; twenty-three working days over six calendar weeks. The e-learning was available, but not accessed by learners, outside of non-workplace time.

Activity records for user profiles of: *Administrator*, *Guest*, *Tester* and *Demonstration* accounts were not recorded.

Records with *System* or *Forum* or *Page* or *File* data in the *Component* field are not relevant to activity being studied and were removed.

The appropriate Visual/Verbal Level Tag is assigned to each learner record in the spreadsheet (Figure 6). The Moodle *Event context* field content is analysed and assigned a label of “PDF”, “Video” or “Interactive”, allowing identification of the media used by learners. (Appendix 12)

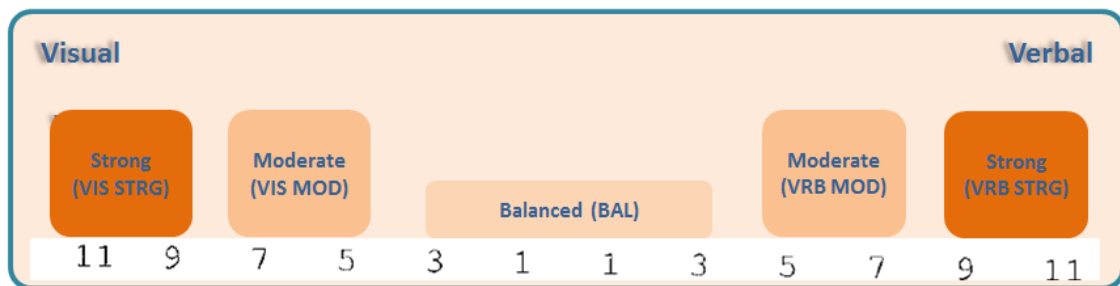


Figure 5. The learner- on the Visual/Verbal dimension depending on ILS score

Findings

The following is an outline of the findings from this research study. This section begins with demographic information from the research respondents. The results presented show how the learner style position on the Visual/Verbal Learner Style dimension scale of the ILS relates to the type of media chosen.

Placing the study in context, the figures 6 to 8 describe the sample group in terms of age, gender and education level. Figures 9 to 12 show levels of media interaction, revealing the majority of interactions were with Interactive media.

To display a balance of interactions over unequal sized learner groups, the data is displayed in a Balanced Histogram and a Percentage Stacked Column Chart.

Finally, statistical analysis software, SOFA, is used to run a Chi Squared test on the two variables, Media Choice and Learner style, to determine if any evidence of correlation exists.

Description of Study Group

Age Profile of the Group

Age Profile shows 62% (n.13) participants in the age group 35-54 and a further 29% (n.6) within the 25-34 band, a total of 91% (n. 19) within the 25-54 range.

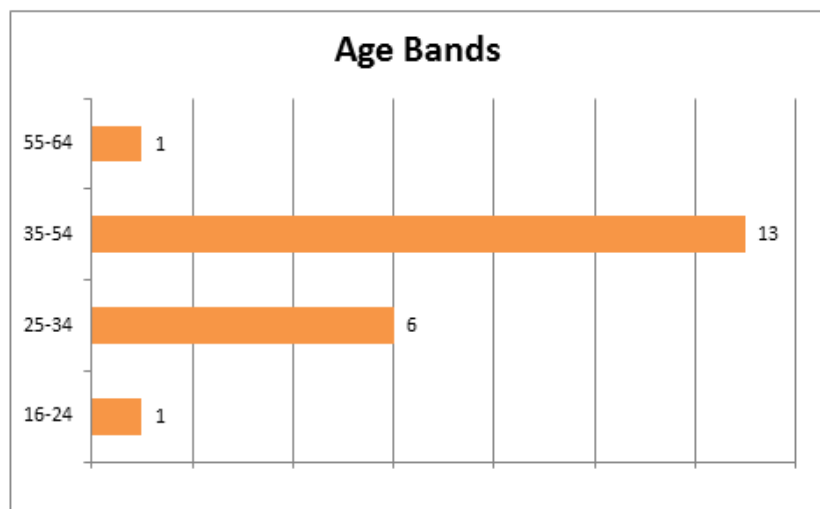


Figure 6. Age Profile of the Group

Education Profile

The education profile of the group studied ranges from those with Further Education to those at Postgraduate level with the Postgraduates making up the majority of 38% (n. 8) followed closely by 33% (n.7) in Further Education and 29% (n.6) at Third level.

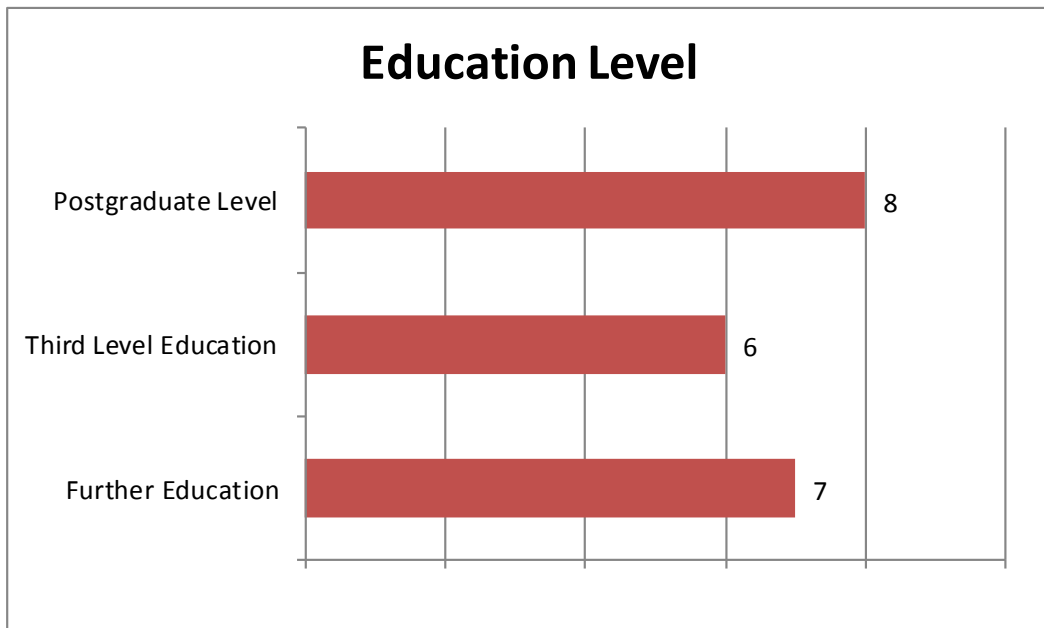


Figure 7. Education Profile

Gender Profile

The majority, 76% (n.16), were Female and 24% (n.5) Male

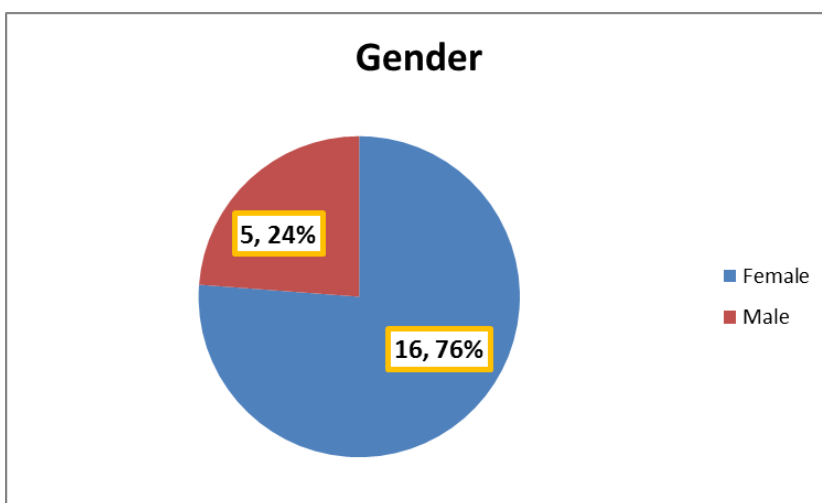


Figure 8. Gender Profile

The Range of Visual / Verb Learner Styles in the Group

The largest group of learners was the one tagged as “Balanced” at 38% (n.8) with Verbal Moderate second largest at 24% (n.5) and Visual Moderate next at 19% (n.4). Only 19% (n.4) showed at the Strong ends of the dimension (2 in each slot).

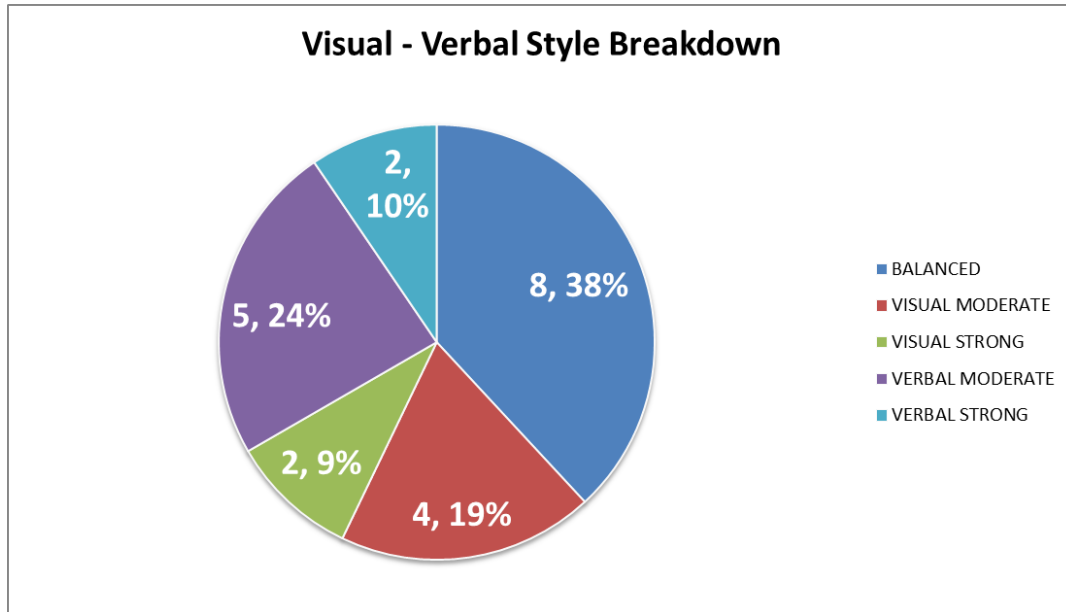


Figure 9. Breakdown of Learner Style by Number and Percentile

Overview of the Use of Media

Of the 340 interactions on the Moodle platform relating to e-learning, 82% (n.278) of all the interactions were with interactive media. The passive video watching provided 16% (n.53 interactions) while access to the PDF files happened only 3% (n.9 times). Balanced learners choose Interactive media 65% (n.181) of the time. A possible reason for the popularity of the Interactive Media is that there were more Balanced learners in this case study.

Table 3. Media types accessed by learners

	Media Access count	Percent of total
Interactive	278	82%
PDF	9	3%
Video	53	16%
Total Access	340	

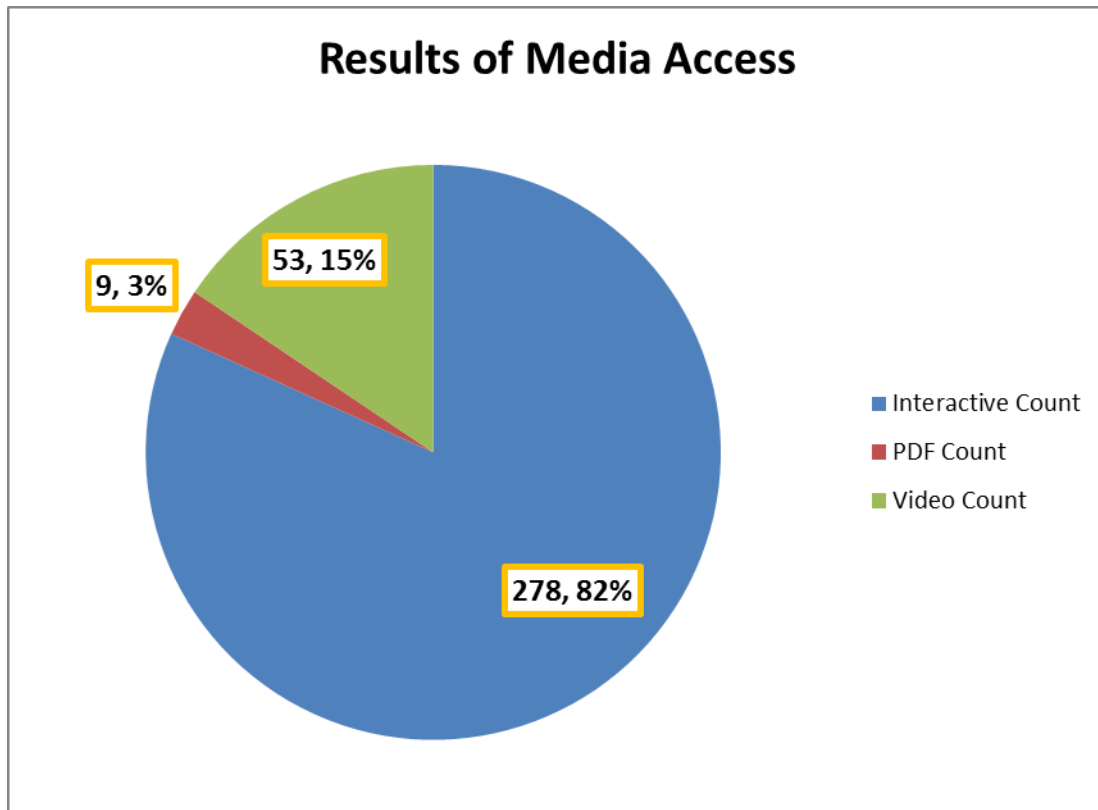


Figure 10. Overall Media Usage (amounts of interactions with media)

Media Choices of the Group Studied

Interactive is the most popular choice getting 83% (n. 278) of interactions.

Table 4 Media choice by learning style (percentage)

Tendency of Media Choice by Position on Visual / Verbal Dimension						
	BAL	VIS MOD	VIS STRG	VRB MOD	VRB STRG	Grand Total
Interactive	65%	12%	8%	12%	2%	1
PDF	22%	33%	11%	33%	0%	1
Video	51%	26%	0%	23%	0%	1

Learner tags are distributed across each media (Figure 11) showing the percentage of interactions that occurred for each learner style as expressed on the Visual/Verbal dimension. It is possible to see that Moderate learners did not have as large a preference for Interactive as the Balanced learners.

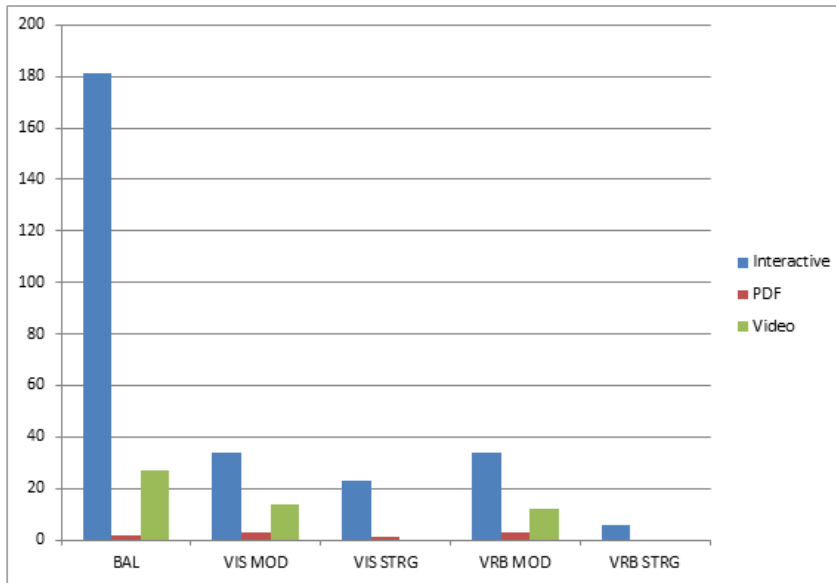


Figure 11. Count of the interactions with media by Learner Groups

Figure 12 displays that, surprisingly, Video was not a choice of any Visual-strong learner, PDF choice was almost equal between all learner groups and Balanced learners showing a marked preference for Interactive media.

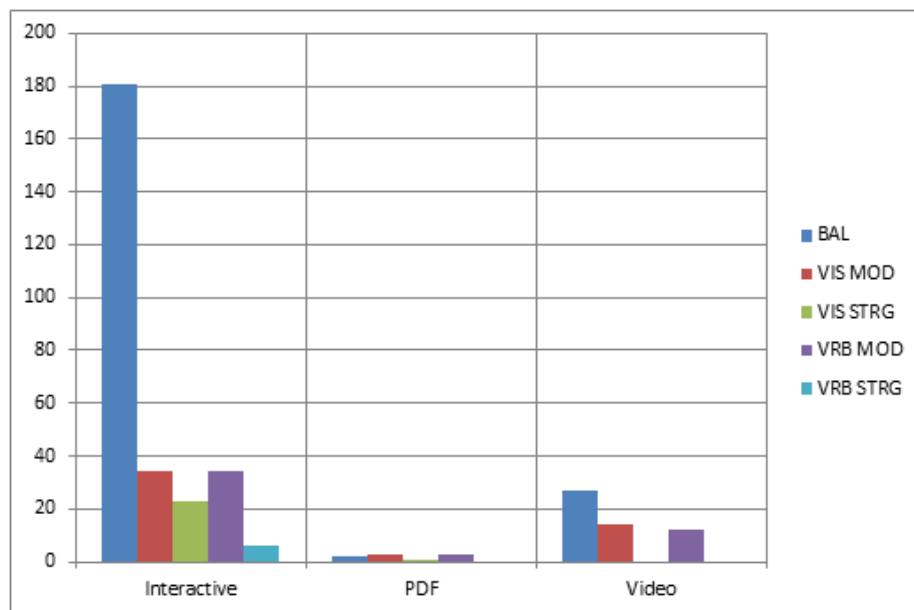


Figure 12. Learner Groups interactions by media

Interactive Media was chosen by Balanced 65% (n.181) of the time, a clear preference over the other media.

PDF was not chosen by any Verbal-strong learner. Visual-strong learners had only an 11% (n.1) tendency to choose PDF. For learners who were Moderate on the dimension scale, PDF was equally as popular (33%) (n.3). Their tendency was higher than the Balanced learners who choose PDF 22% (n.2) of the time.

For the Video media, Balanced learners showed a 51% preference (n.27). It was not used any learner on the Strong position of the dimension and almost equally (23% (n.12) and 26% (n.14) by the Moderate learners.

All learner types showed a preference for Interactive Media. PDF was not popular among any learner type.

Balancing of the two variables

Distribution of Interactive media use

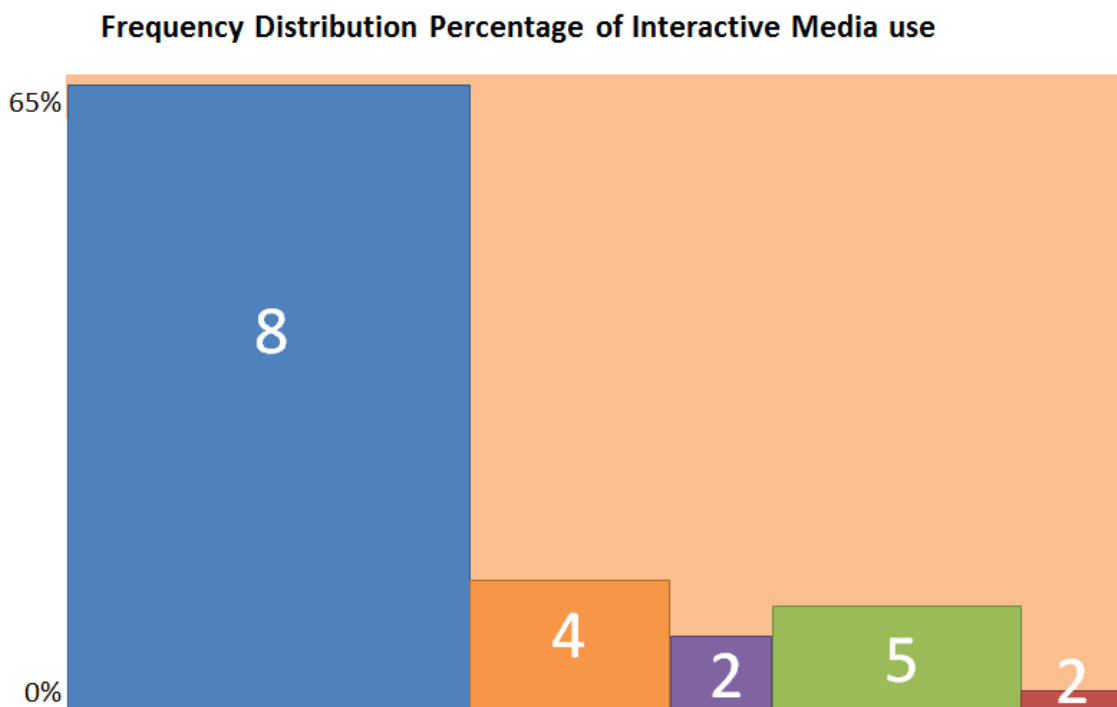


Figure 13. Balanced Histogram

The balanced histogram (Figure 14) shows the influence on the volume of Interactive interactions caused, in part, by the amount of users in each learner style group. Where

the column is wider it indicates a larger number of learners were available to use that media. For instance, the first Blue column has eight users and is eight units wide.

Amount of Learners in each dimension grade of the histogram	
BALANCED	8
VISUAL MODERATE	4
VISUAL STRONG	2
VERBAL MODERATE	5
VERBAL STRONG	2

There was not an equal amount of learner styles present in the study. For instance, eight Balanced learners contributed to the 181 Interactive Interactions but there were only two Visual Moderate learners making 34 Interactive Interactions. The Chi Squared test and a 100% stacked chart display some valid balanced comparisons.

Table 5 Numbers of each Learner Type in the study, Total 21

BALANCED	8
VISUAL MODERATE	4
VISUAL STRONG	2
VERBAL MODERATE	5
VERBAL STRONG	2

Table 6 Interactions with media taken by Learner Types

	BAL	VIS MOD	VIS STRG	VRB MOD	VRB STRG
Interactive	181	34	23	34	6
PDF	2	3	1	3	
Video	27	14		12	
Grand Total	210	51	24	49	6

Levelling of those figures is show in Figure 14 and in the Chi Squared test.

Relationship between Learner Styles and Media Choice

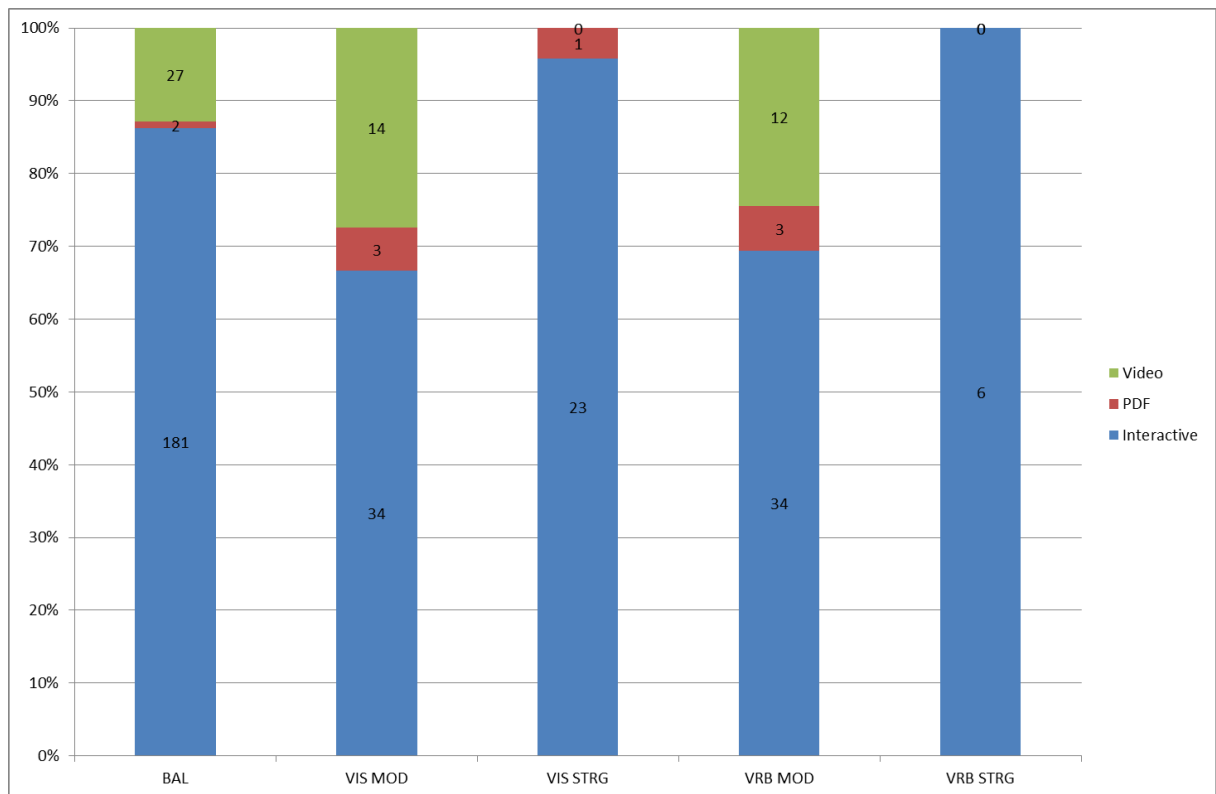


Figure 14. 100% Stacked Column Chart Compares the percentages

The chart in Figure 15 compares the percentage that each learner group contributes to the total media use across all media types. Noteworthy is the fact that the learners placed on the Strong ends of the Visual/Verbal Dimension (VIS STRG and VRB STRG) interacted almost exclusively with the Interactive media and never used the Video media. Balanced learners show little inclination to use the PDF media, and Verbal Strong do not ever use PDF media.

Correlation of the two variables

Previous charts and tables (Figures 11-13) give an overview of media choices. Within that data there are different amounts of learners in each learning style group. There are also different amounts of media choices in each of the media types. A Chi Squared test is used to establish if “a measure of the degree of association or linkage between the two variables” - Style and Media, exists (Robson, 2002, p.148).

Results of Pearson's Chi Square Test of Association between "Style" and "Media"

All, 340, media interactions included.

p value: 0.003

Pearson's Chi Square statistic: 23.343

Degrees of Freedom (df): 8

		Media							
		Interactive		PDF		Video		TOTAL	
		Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp
Style	BAL	181	171.7	2	5.6	27	32.7	210	210.0
	VIS MOD	34	41.7	3	1.3	14	7.9	51	51.0
	VIS STRG	23	19.6	1	0.6	0	3.7	24	24.0
	VRB MOD	34	40.1	3	1.3	12	7.6	49	49.0
	VRB STRG	6	4.9	0	0.2	0	0.9	6	6.0
	TOTAL	278	278.0	9	9.0	53	53.0	340	340.0

Figure 15. Pearson's Chi Square Test, SOFA Statistical Software

Minimum expected cell count: 0.159

% cells with expected count < 5: 46.7

If p is small, e.g. less than 0.01, or 0.001, you can assume the result is statistically significant i.e. there is a relationship (Paton-Simpson, 2014)

Accordingly, in this study, it is not concluded that there is evidence displayed of a relationship between Learner Style and chosen Media.

Discussion and Conclusion

It is recognised that correlation between the variables, Learner Style and Media Choice, does not necessarily indicate that one *causes* or *is caused* by the other, merely that a relationship exists and this is a reference to correlation. Other influencing factors may be present that the researcher has not taken into account in this study. Therefore, this study does not purport to prove causation, which would require greater numbers of respondents and much more detailed statistical analyses. Rather this study highlights various correlations merely as indicators of interesting activity within the study highlighting tendencies.

Media Preferences

The findings however point to a clear preference of all learners for Interactive media and a lack of preference for PDF manuals. There was a notable avoidance of video by Verbal Strong and Visual Strong learner types, with Verbal Strong learners avoiding PDF entirely (Figure 14). However, it is not concluded that there is evidence of a relationship in this study between Learner Style and chosen Media.

Interactive media was the most popular choice across all learner types, reflecting research that indicates e-learners require high quality interactive content. The preference for Interactive (82% n.278) and the low use (3% n.9) of non-interactive PDF indicates that learners seek media that emulates the interactivity and engagement they can get from other modern sources such as games, social media, mobile learning, streaming video *etc.* (Conole, de Laat, Dillon, & Darby, 2006).

Conceptual Framework contribution to interactive media development

The Conceptual Framework (Cisco Systems, 2008; Franzoni & Assar, 2007; adapted by Murphy, 2014) was used to inform interactive multi-media development.

The third additional column contributes to the conceptual framework on how to develop e-learning to match different learning styles and mix media to enhance pedagogical effectiveness. The framework can be further developed to include other media and to advise on optimum media mixtures. The level of effectiveness of the framework could be the subject of a future study.

Research Instrument critique

The instruments used to gather data on learner age and educational levels were deficient. Equal bracketing of the age scales is absent. The 25-54 band has twenty ages where other bands encompassed ten. Therefore, this data could only be interpreted in the broadest sense, describing the population overall age group. In hindsight, terms used to indicate educational level were ambiguous and not explicit enough to have the same meaning to all readers. This is a factor which could be given greater consideration in any further study. Since neither age nor educational level were used to process or correlate any data, it is the opinion of the researcher that the deficiencies did not adversely affect the validity of the findings. Future deployment of this or similar studies could use similar templates for the data collection, given that these points are remedied.

The instruments did collect gender information but it was not used to disaggregate the data noting whether there were any distinct preferences in the male/female approach to media selection. However, this could still be achieved.

Observation of data patterns

The results of this study show that identifying a learning style and media type can produce data that display the pattern of media use in an e-learning course of study. This data pattern can advise and support the e-learning development and the adjustment of existing e-learning media-mix. Providers of e-learning can use the data-analytics

correlated with learning style to observe how participants are choosing to learn, leading to greater insight and awareness when preparing learning material (Graf, Kinshuk & Liu, 2009).

Opportunities for Adaptivity/Adaptability using ILS as pre-test

From other research studies, it is recognised that there are other factors involved in influencing the learner choice of media (Brusilovsky 1996; Sadat & Ghorbani 2004). Nonetheless, learning styles remain one notable aspect of learners' preferences. As such, using the ILS to act as a learner style pre-test can act as a guideline to e-learning developers in their provision of media for a corporate workplace environment, thereby avoiding development of e-learning solutions that contain every possible media and media combinations as the "pedagogical sheep dip" attempt to provide equal access to all learner styles (Learning and Skills Research Centre, 2004, p. 3). All adjustments made to the media or media-mix can be considered adaptive (Lee & Park, 2008). Adjustment, based on learners' style, can automatically be made to the e-learning navigation or content using software. Alternatively, adjustment can be initiated by a tutor/instructional designer. In this study elements of the e-learning solution are under the control of the researcher. In such a situation a developer can observe patterns in learner activity and react by adjusting the e-learning to accommodate navigation, content and media requirements of the specific audience (Scenarios in Appendix 13)

Authoring software role in e-learning Adaptivity/Adaptability

Usage of the authoring software highlights limitations in the software's abilities to rapidly develop the three different media used in this study. However, developers should evaluate future software versions to see if a single capture of instruction can effectively output to multiple media (*e.g.* Interactive, Video, PDF). Kolb (2002)

suggests providing a way for all learners, regardless of their learning style, to engage with the content. This may precipitate learners using learning styles other than their predominant one (*cited in* Delahoussaye, 2002). The provision of several supporting instructional media could contribute to providing e-learning that has the adaptability of allowing learners to choose for themselves the media they feel they require for their learning experience (Burgos, Tattersall, & Koper, 2007).

Limitations

Results of this case study may be influenced by the e-learning subjects (Office Procedures/Software use). In other words, subject matter of a more academic nature, of higher-order-thinking, or requiring complex calculations may cause the same learners to make different media choices (Ennis, 2000; Gardner, 1993)

The study was based on learners in one legal firm and conducted over a short period. This research could benefit by studying a greater number of participants to provide a more diverse range of learner styles. There were only two Verbal-Strong and Visual-Strong learners. Hence, no definitive correlations can be drawn from the research. This could be developed into a longitudinal study which may yield more interesting insights.

Future studies might explore the rationale for the learner choice by conducting post-training focus groups/interviews exploring reasons and influencing factors, apart from learner styles, for the media choice.

Assessing learner style once at the study beginning ignores the fact that style may not be a constant trait (Akbulut & Cardak, 2012). Several surveys during the study may be a better determination of style.

Some of the study limitations: the amount and variety of respondents and the narrow

focus of subject material, mean that only limited data could be harvested thus limiting findings. However, more research could be done in this area. For instance, this study could be conducted with more companies in Cork using a multiple case study, cross-case comparative approach comparing results to see if they are similar or different.

Ease of data collection using Moodle content configuration

The objective of this case study is to examine the relationship between learning styles and learner choice of media. It uses the FSLMS Visual/Verbal dimension to indicate media preferences demonstrating that the three data sources can be collected and merged to display relationships and patterns of media use. The method created for collection of analytical data from Moodle shows how administrators can develop and label media to exploit the built-in abilities of the LMS reporting systems, thereby revealing a rich but easily accessible source of information in corporate or academic environments (Appendix 12).

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Appendix 1 Details of the lesson media types

The Interactive Simulation is delivered in a slide-by-slide presentation and it requires the learner to click the hotspots to move on to the next part of the lesson. The hotspot will normally be over an area of a video or image or software screen. This area will have been mentioned in an instruction previously. Where a hotspot is not appropriate a button marked “Continue” or similar is provided. Such buttons are provided at menu sections and major section breaks, such as before a review quiz.

The Video Walk-through has the same content as the Interactive Simulations but no interaction with the instructional content is possible or required. All the hotspot clicking present in the Interactive Simulation is absent and the process is just like passively watching a video. The video player itself can be paused, stopped and

(Both the Interactive Simulations and the Video Walk-through contain a menu system to allow non-linear study.)

The PDF is in a training manual format. It gives step-by-step instruction in a document that can be viewed on-screen or printed out. Each PDF contains text instructions and visuals such as: Screen grabs from software, photographs of office equipment, diagrams, and illustrations.

Examples of each available media type available at the e-learning website.

Appendix 2 - The questionnaire to collect the demographic information

Learning Support Data Collection Form

Individual information

*** Required**

Your Name *
Please enter your Firstname and Surname

Gender
Please select your Gender from the drop-down list

Age Band
Give an idea as to your age

☐ 16-24
☐ 25-34
☐ 35-54
☐ 55-64
☐ 65+
☐ Prefer Not to Answer

What is the highest level of education you have completed
Tick One box

☐ Primary School
☐ Secondary School
☐ Further Education
☐ Third Level Education
☐ Postgraduate Level
☐ Other:

How would you describe your computer skills?

1 2 3 4 5

Extremely Poor ☐ ☐ ☐ ☐ ☐ Excellent

Which of these would you use frequently (one or more times a week)

Select all that apply to you

- ☐ Mobile phone
- ☐ Smart Phone
- ☐ Tablet Computer (ipad or similar)
- ☐ Laptop Computer
- ☐ Desktop Computer
- ☐ Other:

Online Activity - Which of these would you do frequently (one or more times a week)

Select all that apply to you


- ☐ Download of Movies
- ☐ Download of Music
- ☐ Reading Blogs
- ☐ Viewing FaceBook
- ☐ Viewing Twitter
- ☐ Viewing Google +
- ☐ Other:

Online Contributions - Which of these would you do frequently (one or more times a week)

Select all that apply to you

- ☐ Writing Blog posts
- ☐ Commenting on blog posts
- ☐ Responding on FaceBook (comments, Likes, Updates)
- ☐ Creating Twitter Tweets
- ☐ Responding to Twitter Tweets (retweets, likes, comments)
- ☐ Contributing to Google +
- ☐ Other:

Never submit passwords through Google Forms.

 100%: You made it.

Appendix 3 – Email of the ILS url & instructions on return of the ILS result to the author.

Hi Again,

This is information on a second learning survey.

This is an online one. It has 44 questions.

The questions are **short** & it will take **5 minutes** approximately to fill in.

It works better if you don't spend too much time thinking about the questions.

Give your first reaction rather than think for ages about each question.

It is a Survey that tries to determine a student **Learning Style**.

When complete it will list a style summary for you on-screen.

When you complete all questions click **SUBMIT BUTTON** at screen end to complete

IMPORTANT:

You then need to **send the results** to me with a reply to this email

This is the link to the survey:- <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

To send me results of the survey

you could:

Press CONTROL P at the survey results to print the page, put their name on page, scan & email back to me *OR*

Email me to give the reading (wherever the **X** is) by typing it in (for instance - ACT 5, INT 9, VRB 3, SEQ 1) *OR*

Screen grab the results page with Prt-Scr button, paste int an email with CONTROL V and email to me

This is a sample how the results display: (look for the **X** above each row)

Results for: Learner001

ACT 11 9 7 5 3 1 1 3 5 7 9 11 REF

SEN 11 9 7 5 3 1 1 3 5 7 9 11 INT

VIS 11 9 7 5 3 1 1 3 5 7 9 11 VRB

SEQ 11 9 7 5 3 1 1 3 5 7 9 11 GLO

There will be an **X** above each row

The **X** shows where you are on the 4 scales to indicate your style.

I need to know the 4 **X** for your result

Appendix 4 Emails sent for the demographic questionnaire

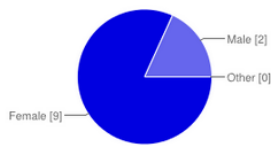
Hi, as part of an upgrade to FitzGerald Solicitors Staff Learning Support we are installing an online e-learning platform that will be available for all staff to use.

As part of my research into e-learning I would be grateful if you could take a minute to complete this online survey.

All data is completely confidential. Only I get to see the returns. Findings and results of the research will not mention anyone's name or identifying details

Appendix 5 – Google Form Analytics

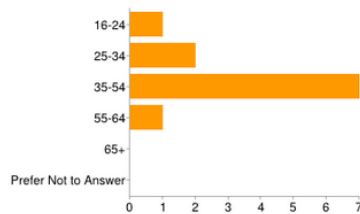
Gender



Female	9	82%
Male	2	18%
Other	0	0%

Google Drive Form Analytics is available for the data collected through Google Drive, but was not used as an analysis tool in this case study. Illustrations shown here only as an example.

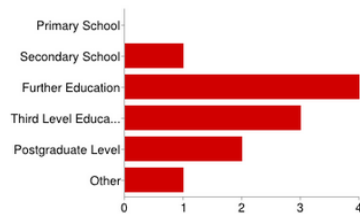
Age Band



16-24	1	9%
25-34	2	18%
35-54	7	64%
55-64	1	9%
65+	0	0%
Prefer Not to Answer	0	0%

Final collected data in this study

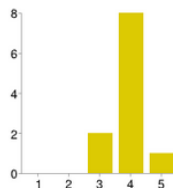
What is the highest level of education you have completed



Primary School	0	0%
Secondary School	1	9%
Further Education	4	36%
Third Level Education	3	27%
Postgraduate Level	2	18%
Other	1	9%

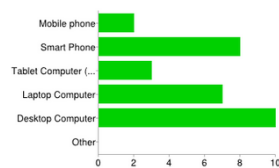
was collated and analysed in Microsoft Excel.

How would you describe your computer skills?



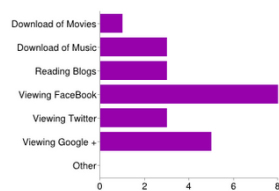
1	0	0%
2	0	0%
3	2	18%
4	8	73%
5	1	9%

Which of these would you use frequently (one or more times a week)



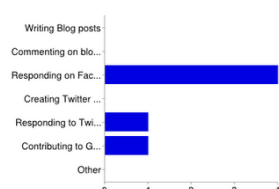
Mobile phone	2	7%
Smart Phone	8	27%
Tablet Computer (ipad or similar)	3	10%
Laptop Computer	7	23%
Desktop Computer	10	33%
Other	0	0%

Online Activity - Which of these would you do frequently (one or more times a week)



Download of Movies	1	4%
Download of Music	3	13%
Reading Blogs	3	13%
Viewing FaceBook	8	35%
Viewing Twitter	3	13%
Viewing Google +	5	22%
Other	0	0%

Online Contributions - Which of these would you do frequently (one or more times a week)



Writing Blog posts	0	0%
Commenting on blog posts	0	0%
Responding on FaceBook (comments, Likes, Updates)	4	67%
Creating Twitter Tweets	0	0%
Responding to Twitter Tweets (retweets, likes, comments)	1	17%
Contributing to Google +	1	17%
Other	0	0%

Appendix 6 Excel Spreadsheet combining data from Questionnaire and ILS

	A	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	username	ACT	REF	SEN	INT	VIS	VRB	SEQ	GLO	Gender	Age	education	skills	use	do	Contribut
2				3	1			7		3 Female	25-34	Postgraduate	3 Phone, Desktop	Download	Other: LinkedIn	
7				3	9		1		1	Female	35-54	Education	4 Computer	FaceBook		
15				3	5			7	3	Female	35-54	Education	4 phone,	Google +		
16		1			5			9	1	Female	35-54	e Level,	3 Phone,			
19				1	1		11		5	Female	35-54	Education	4 Phone,	Blogs,	on FaceBook	
21				1	5			5	7	Female	25-34	Education	4 Phone,	of Music,	to Twitter	
25		1			5		1		1	Female						
26																

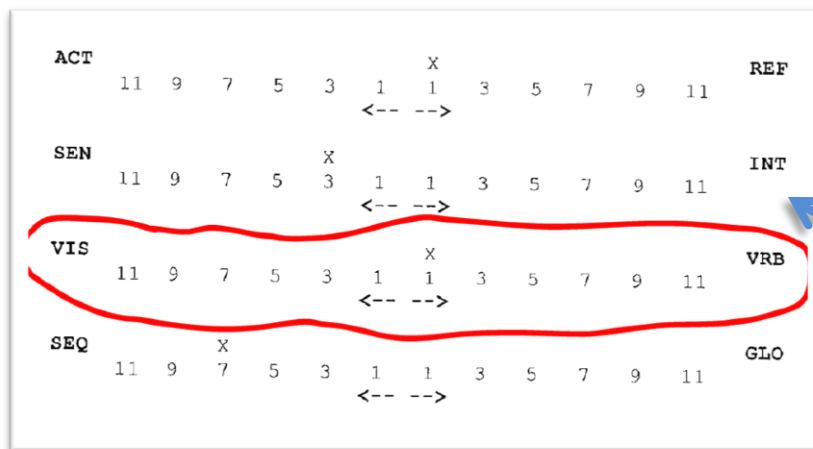
Appendix 7 ILS instructions and Spreadsheet Lookup table assigning a text label to result

(A). Lookup table

result	style
-11	VIS STRG
-9	VIS STRG
-7	VIS MOD
-5	VIS MOD
-3	BAL
-1	BAL
1	BAL
3	BAL
5	VRB MOD
7	VRB MOD
9	VRB STRG
11	VRB STRG

Lookup table content is derived from **C. ILS instructions** and used with an Excel spreadsheet VLOOKUP function

(B). Example ILS polar scale results




Sample ILS result showing placement of +1 on the Visual / Verbal Dimension

Explaining the score & its implications for learner's style. (as displayed on the ILS result sheet)

(C). ILS Instructions / Interpretation


- If your score on a scale is 1-3, you are fairly well balanced on the two dimensions of that scale.
- If your score on a scale is 5-7, you have a moderate preference for one dimension of the scale and will learn more easily in a teaching environment which favors that dimension.
- If your score on a scale is 9-11, you have a very strong preference for one dimension of the scale. You may have real difficulty learning in an environment which does not support that preference.

Appendix 8 e-learning menu for *More Software* section in Moodle



More Software




Other applications used in our office




Interactive

Instructional Simulations

Audio / video Instructional Simulations that wait for your interactions with the scene. Your participation is vital to the success!




-  Using Email- Outlook and eXpd8
-  Using CORT- Requisitions on Title
-  Revenue E-Stamping- Stamp Duty




Video

Audio / Visual instruction

Screen-cast with audio instruction. You can just sit back and watch!


-  Outlook Email Video
-  Using Cort Software Video
-  Revenue E-Stamping Video



PDF Manuals

Illustrated instruction manual

Step-By-Step Lesson instruction manuals showing How-To-Do-It!
Complete with text and images. Available to read, download and print.

-  PDF Manuals to View and Download

The **Interactive** media requires the learner to click on hotspots to move to each part of the lesson.

The **Video** has the same content as the Interactive media but no interaction is required. All the hotspot clicking is absent and the process is of passively watching a video. The **PDF** is in a training manual format with step-by-step instructions that can be viewed on-screen or printed.

Appendix 9 Media Development Matrix

Multimedia Development Matrix (Cisco Systems, 2008; Franzoni & Assar, 2007)

Title	Media Usage
Multimedia Principle	Retention is improved through words and pictures rather than through words alone
Spatial Contiguity Principle	Students learn better when corresponding words and pictures are presented near each other rather than far from each other on the page or screen
Temporal Contiguity Principle	Students learn better when corresponding words and pictures are presented simultaneously rather than successively
Coherence Principle	Students learn better when extraneous words, pictures, and sounds are excluded rather than included
Modality Principle	Students learn better from animation and narration than from animation and on-screen text.
Redundancy Principle	Students learn better when information is not represented in more than one modality – redundancy interferes with learning.

Appendix 10 Conceptual Framework for e-learning media creation

Title	Media Usage	Guideline created for use in this study to advise media development (Murphy, T., 2014)
Multimedia Principle	Retention is improved through words and pictures rather than through words alone	Use text and imagery Use image/video and voice-over
Spatial Contiguity Principle	Students learn better when corresponding words and pictures are presented near each other rather than far from each other on the page or screen	Place text titles and captions close to the visual they refer to. Use a cartoon balloon or pointing arrow to associate the text with the image or part of the image.
Temporal Contiguity Principle	Students learn better when corresponding words and pictures are presented simultaneously rather than successively	Include text captions at the point where the process or function is mentioned or displayed in video and images.
Coherence Principle	Students learn better when extraneous words, pictures, and sounds are excluded rather than included	Use concise language. Include only relevant imagery and video. Crop to the important part of video and images.
Modality Principle	Students learn better from animation and narration than from animation and on-screen text.	When using animation where possible use a voice-over rather than text captions.
Redundancy Principle	Students learn better when information is not represented in more than one modality – redundancy interferes with learning.	Text titles and captions should not consistently exactly match the voice-over.
(Cisco Systems, 2008; Franzoni & Assar, 2007)		

Appendix 11 Chronology of e-learning Design and Development

<i>e-learning Milestones</i>
Learning needs analysis, Syllabus of subject matter created
Subject Matter Panel recruited
Learning Outcomes Defined
Script created in text format
Multimedia lessons prototype of the software usage simulations created in Captivate
Review Quiz added to Captivate lesson
Sample prototype Lessons Pilot run in the company
Content and design of prototype lessons review by client management and Subject Matter Panel. Revisions and adjustments suggested for the software usage simulations. Colour scheme adjustments suggested for the design. Alternative presentation via Storyline cartoon character decided for the Office Procedures instruction
Colour scheme alternatives created and shown to client and approved scheme is selected.
Revisions and adjustments applied to Captivate source files. Adjustments approved by client.
Storyline prototype approved for the Office Procedures instruction
Domain Name selection & approval and Hosting acquired
Moodle deployment, Theme and configuration & approval
Course menu constructed in Moodle

Appendix 12 Configuration in Moodle

Naming Elements

Name the learning elements in Moodle in a consistent way.

Media	Naming Convention	Example Name
Interactive choice	by just a name	Alarms
Video Walk-Through media	the name with the additional suffix <i>Video</i> appended	Alarms Video
The Folder containing the PDF media	Folder name and suffix <i>Manuals</i>	<i>PDF Manuals</i>

Construct Excel Workbook

Responses from the Google Form demographic questionnaire (Appendix 2) are automatically collated into a Google Spreadsheet. The spreadsheet is downloaded in Microsoft Excel format for analysis (herein referred to as **Workbook01-Worksheet01**). Learners' *Name* was a required field in the questionnaire. Naming or identifying each user allows matching the ILS return with user activity in Moodle to the same learner. Anonymity was guaranteed in advance (Appendix 4).

username	el use	demog returned	style rtnd
user101	YES	YES	YES
user102	YES	YES	YES
user103	YES	YES	YES

Sampling was governed by those who returned the questionnaire and ILS data. They were then included in the study if they also used the e-learning.

The fields "el use", "demog returned" and "Style rtnd" are appended to **Workbook01-Worksheet01** to allow tracking of user completion of the ILS Style survey, the Demographic Questionnaire and to log whether respondent used the e-learning system (did they have activity listed in the Moodle logs)

Scores on each dimension the FLSM Index of Learning Styles (ILS) data returns are manually transferred to **Workbook01-Worksheet01**. (Fields "ACT, REF, SEN, INT, VIS, VRB")

H	I	J	K	L	M	N	O
ACT	REF	SEN	INT	VIS	VRB	SEQ	GLO
		3	1			7	3
3			7		3		1
5			7		3		5
1			9		1		9
		9	7			1	5

ILS dimension three data added

Two fields are added to **Workbook01-Worksheet01**, "VIS-VERB" and "VV-Group"

The position of the learner on the Visual Verbal dimension of the ILS data result is determined by an IF function in the “VIS-VERB” field. The content of the “VIS-VERB” field is used in a “Vlookup” function in the “VV-Group” field. The Vlookup function calls data from a lookup table (Appendix 7). The lookup table content is derived from the instructions contained in the results page of the online ILS (Appendix 7) According to their position on the ILS Visual Verbal dimension scale learners are tagged with an identifying text label from the lookup table.

Q	R
VIS-VERB	VV-Group
-3	BAL
7	VRB MOD
-3	BAL
-1	BAL

Activity from Moodle data logs are constructed

Get data on user activity from Moodle logs- Site Administration -> Reports-> Logs.

Generate one log output per each learner. Download each log and combined in Excel.

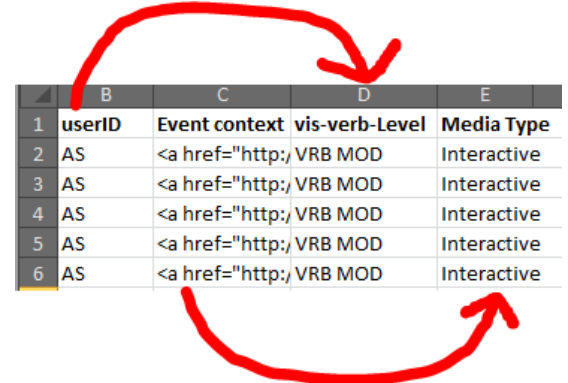
Place into a new worksheet (**Workbook01-Worksheet02**) (Download button available in the report window of Moodle log output)

Note: This study used a CSV export format rather than an Excel format due to technical issues with the Excel exports from Moodle.

If there are any downloaded activity records for user profiles of: *Administrator*, *Guest*, *Tester* and *Demonstration* accounts these records need to be removed from Worksheet1.

Records with *System* or *Forum* or *Page* or *File* data in the *Component* field are not relevant to the user and media activity being studied in this case study and, in this case, are removed.

In **Workbook01-Worksheet02** the “User ID” content can provide a variable to a Lookup Function to identify the learner style (in the “vis-verb-Level” field). The “Event Context” content can provide a variable to a Lookup Function to identify the Media (in the “Media Type” field).



	B	C	D	E
1	userID	Event context	vis-verb-Level	Media Type
2	AS	<a href="http://	VRB MOD	Interactive
3	AS	<a href="http://	VRB MOD	Interactive
4	AS	<a href="http://	VRB MOD	Interactive
5	AS	<a href="http://	VRB MOD	Interactive
6	AS	<a href="http://	VRB MOD	Interactive

Example of Excel Pivot Table applied to data in **Workbook01-Worksheet02**

	A	B	C	D	E	F	G
4	Row Labels	BAL	VIS MOD	VIS STRG	VRB MOD	VRB STRG	Grand Total
5	Interactive	181	34	23	34	6	278
6	PDF	2	3	1	3		9
7	Video	27	14		12		53
8	Grand Total	210	51	24	49	6	340

Appendix 13 Developer configurable Adaptive and Adaptable scenarios

All adjustments made to the media or media mix used for instruction can be considered adaptive (Lee & Park, 2008). Adjustment, based on learners' style, can automatically be made using software or be initiated by a tutor or instructional designer. Where the elements of an e-learning solution are under the control of a company, the following adaptive scenarios are viable approaches to support students by considering their individual learning styles:

A: Conduct a learning style survey and categorise each learner (illustrated in Appendix 7). Where it is found that the population is comprised of all learner styles it would be worth considering developing an adaptable system of e-learning (allowing the learners to choose for themselves the most appropriate media) containing media that will suit all styles of learner. Where the population is composed of only some learner styles or has a predominance of a few styles, one might create only the media that will facilitate their learning and omit other media types.

B: Limit the provision of media in the e-learning as is dictated by resources and subject matter. Test to discover learner's learning style. Evaluate the provided media in relation to learning styles of the group. Where it is determined that a learning style may not be allowing optimised learning to occur for a learner using the e-learning media the company can consider providing: additional learning formats (one-to-one coaching, classroom, blended, etc.) or it may be that these learners simply need to be monitored more closely in their e-learning and evaluations to insure they are learning as required.

Appendix 14 SOFA statistics Software

URL: <http://www.sofastatistics.com>

Paton-Simpson, G., SOFA statistics Software. (2014). Version 1.4.3, open source AGPL3 licence 2009-14; Paton-Simpson & Associates Ltd

Lead Developer: Dr Grant Paton-Simpson